LMF Operating System Installation

This section provides information and instructions for installing and updating the LMF software and files.

NOTE	**First Time Installation Sequence:** 1. Install Java Runtime Environment (JRE) 2. Install U/WIN K–shell emulator 3. Install LMF application programs 4. Install/create BTS folders

NOTE	Any time you install U/WIN, you must install the LMF software because the installation of the LMF modifies some of the files that are installed during the U/Win installation. Installing U/Win over–writes these modifications. There are multiple binary image packages for installation on the CD–ROM. When prompted, choose the load that corresponds to the switch release that you currently have installed. Perform the Device Images install after the WinLMF installation. If applicable, a separate CD ROM of BTS Binaries may be available for binary updates.

Follow the procedure in Table 3-1 to install the LMF application program using the LMF CD ROM.

Table 3-1: Install LMF using CD ROM

✓	Step	Action
	1	Insert the LMF CD ROM disk into your disk drive and perform the following as required:
	1a	– If the Setup screen appears, follow the instructions displayed on the screen.
	1b	– If the Setup screen is not displayed, proceed to Step 2.
	2	Click on the **Start** button.
	3	Select **Run.**
	4	Enter **d:\autorun** in the Open box and click **OK.**
		NOTE If applicable, replace the letter **d** with the correct CD ROM drive letter.

Copy BTS and CBSC CDF (or NECF) Files to the LMF Computer

Before logging on to a BTS with the LMF computer to execute optimization/ATP procedures, the correct **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** files must be obtained from the CBSC and put in a **bts-#** folder in the LMF computer. This requires creating versions of the CBSC CDF files on a DOS–formatted floppy diskette and using the diskette to install the CDF files on the LMF computer.

NOTE

- If the LMF has ftp capability, the ftp method can be used to copy the CDF or NECF files from the CBSC.
- On Sun OS workstations, the **unix2dos** command can be used in place of the **cp** command (e.g., unix2dos bts–248.cdf bts–248.cdf). This should be done using a copy of the CBSC CDF file so the original CBSC CDF file is not changed to DOS format.

NOTE

When copying CDF or NECF files, comply with the following to prevent BTS login problems with the Windows LMF:

- The numbers used in the **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** filenames must correspond to the locally-assigned numbers for each BTS and its controlling CBSC.
- The generic **cbsc–1.cdf** file supplied with the Windows LMF will work with locally numbered BTS CDF files. Using this file *will not provide a valid optimization* unless the generic file is edited to replace default parameters (e.g., channel numbers) with the operational parameters used locally.

The procedure in Table 3-2 lists the steps required to transfer the CDF files from the CBSC to the LMF computer. For further information, refer to the *LMF Help function on–line documentation*.

Table 3-2: Copying CDF or NECF Files to the LMF Computer

✓	Step	Action
AT THE CBSC:		
	1	Login to the CBSC workstation.
	2	Insert a DOS–formatted floppy diskette in the workstation drive.
	3	Type **eject –q** and press the **Enter** key.
	4	Type **mount** and press the **Enter** key. **NOTE** • Look for the *“floppy/no_name”* message on the last line displayed. • If the **eject** command was previously entered, *floppy/no_name* will be appended with a number. Use the explicit *floppy/no_name* reference displayed when performing Step 7.
	5	Change to the directory, where the files to be copied reside, by typing **cd <directoryname>** (e.g., **cd bts–248**) and pressing the **Enter** key.
	6	Type **ls** and press the **Enter** key to display the list of files in the directory.

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Table 3-2: Copying CDF or NECF Files to the LMF Computer

✓	Step	Action
	7	With *Solaris versions of Unix, create DOS–formatted versions* of the **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** files on the diskette by entering the following command: **unix2dos <source filename> /floppy/no_name/<target filename>** (e.g., **unix2dos bts–248.cdf /floppy/no_name/bts–248.cdf**).
		NOTE • Other versions of Unix do not support the unix2dos and dos2unix commands. In these cases, use the Unix **cp** (copy) command. The *copied* files will be difficult to read with a DOS or Windows text editor because Unix files do not contain line feed characters. Editing *copied* CDF files on the LMF computer is, therefore, not recommended. • Using **cp**, multiple files can be *copied* in one operation by separating each filename to be copied with a space and ensuring the destination directory (*floppy*/*no_name*) is listed at the end of the command string following a space (e.g., **cp bts–248.cdf cbsc–6.cdf /floppy/no_name**).
	8	Repeat Steps 5 through 7 for each bts–# that must be supported by the LMF computer.
	9	When all required files have been copied to the diskette type **eject** and press the **Enter** key.
	10	Remove the diskette from the CBSC drive.
AT THE LMF:		
	11	If it is not running, start the *Windows* operating system on the LMF computer.
	12	Insert the diskette containing the **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** files into the LMF computer.
	13	Using *MS Windows* Explorer, create a corresponding bts–# folder in the **<*x*>:\<*lmf home directory*>\cdma** directory for each **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** file pair copied from the CBSC.
	14	Use *MS Windows* Explorer to transfer the **bts-#.cdf** (or **bts–#.necf**) and **cbsc-#.cdf** files from the diskette to the corresponding **<*x*>:\<*lmf home directory*>\cdma\bts–#** folders created in Step 13.

Creating a Named HyperTerminal Connection for MMI Connection

Confirming or changing the configuration data of certain BTS Field Replaceable Units (FRU) requires establishing an MMI communication session between the LMF and the FRU. Using features of the *Windows* operating system, the connection properties for an MMI session can be saved on the LMF computer as a named *Windows* HyperTerminal connection. This eliminates the need for setting up connection parameters each time an MMI session is required to support optimization.

Once the named connection is saved, a shortcut for it can be created on the *Windows* desktop. Double–clicking the shortcut icon will start the connection without the need to negotiate multiple menu levels.

Follow the procedure in Table 3-3 to establish a named HyperTerminal connection and create a *Windows* desktop shortcut for it.

Table 3-3: Creating a Named Hyperlink Connection for MMI Connection

Step	Action
1	From the Windows Start menu, select: **Programs>Accessories>**
2	Perform one of the following: • For *Win NT,* select **Hyperterminal a**nd then click on **HyperTerminal** or • For *Win 98,* select **Communications,** double click the **Hyperterminal** folder, and then double click on the **Hyperterm.exe** icon in the window that opens. **NOTE** • If a **Location Information Window** appears, enter the required information, then click **Close**. (This is required the first time, even if a modem is not to be used.) • If a **You need to install a modem.....** message appears, click **NO**.
3	When the **Connection Description** box opens: – Type a name for the connection being defined (e.g., MMI Session) in the **Name:** window. – Highlight any icon preferred for the named connection in the **Icon:** chooser window. – Click **OK.**
4	From the **Connect using**: pick list in the **Connect To** box displayed, select **COM1** or **COM2** (*Win NT)* – or **Direct to Com 1** or **Direct to Com 2** (*Win 98*) for the RS–232 port connection and click **OK.**
	NOTE For LMF configurations where COM1 is used by another interface such as test equipment and a physical port is available for COM2, select COM2 to prevent conflicts.
5	In the **Port Settings** tab of the **COM# Properties** window displayed, configure the RS–232 port settings as follows: • Bits per second: 9600 • Data bits: 8 • Parity: None • Stop bits: 1 • Flow control: None

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Table 3-3: Creating a Named Hyperlink Connection for MMI Connection	
Step	**Action**
6	Click **OK**.
7	Save the defined connection by selecting: **File>Save**
8	Close the HyperTerminal window by selecting: **File>Exit**
9	Click **Yes** to disconnect when prompted.
10	Perform one of the following: • If the **Hyperterminal** folder window is still open (*Win 98)* proceed to step 12 • From the Windows Start menu, select **Programs > Accessories**.
11	Perform one of the following: • For *Win NT*, select **Hyperterminal** and release any pressed mouse buttons. • For *Win 98*, select **Communications** and double click the **Hyperterminal** folder.
12	Highlight the newly created connection icon by moving the cursor over it (*Win NT*) or clicking on it (*Win 98*).
13	*Right click and drag* the highlighted connection icon to the Windows desktop and release the right mouse button.
14	From the pop–up menu displayed, select **Create Shortcut(s) Here**.
15	If desired, reposition the shortcut icon for the new connection by dragging it to another location on the Windows desktop.
16	Close the **Hyperterminal** *folder* window by selecting: **File > Close**

Span Lines – Interface and Isolation

T1/E1 Span Interface

NOTE	**At active sites,** the OMC/CBSC must disable the BTS and place it out of service (OOS). **DO NOT** remove the 50–pin TELCO cable connected to the BTS frame site I/O board **J1** connector until the OMC/CBSC has disabled the BTS!

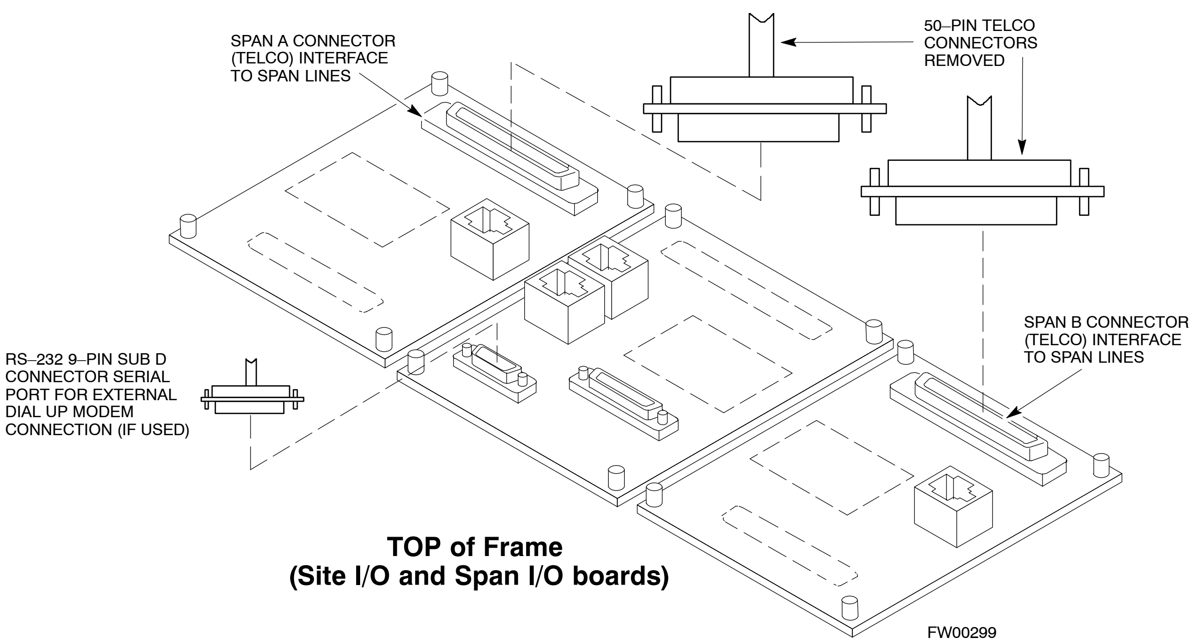
Each frame is equipped with one Site I/O and two Span I/O boards. The Span I/O J1 connector provides connection of 25 pairs of wire. A GLI card can support up to six spans. In the SC 4812T configuration, the odd spans (1, 3, and 5) terminate on the Span "A" I/O; and the even spans (2, 4, and 6) terminate on the Span "B" I/O.

Before connecting the LMF to the frame LAN, the OMC/CBSC must disable the BTS and place it OOS to allow the LMF to control the CDMA BTS. This prevents the CBSC from inadvertently sending control information to the CDMA BTS during LMF based tests. Refer to Figure 3-2 and Figure 3-3 as required.

Isolate BTS from T1/E1 Spans

Once the OMC–R/CBSC has disabled the BTS, the spans must be disabled to ensure the LMF will maintain control of the BTS. To disable the spans, disconnect the span cable connectors from the Span I/O cards (see Figure 3-2).

Figure 3-2: Span I/O Board T1 Span Isolation



T1/E1 Span Isolation

Table 3-4 describes the action required for span isolation.

Table 3-4: T1/E1 Span Isolation	
Step	**Action**
1	Have the OMC/CBSC place the BTS OOS.
2	The T1/E1 span 50–pin TELCO cable connected to the BTS frame SPAN I/O board **J1** connector can be removed from both Span I/O boards, if equipped, to isolate the spans.
	NOTE If a third party is used for span connectivity, the third party must be informed before disabling the span line. Verify that you remove the SPAN cable, *not* the “MODEM/TELCO” connector.

LMF to BTS Connection

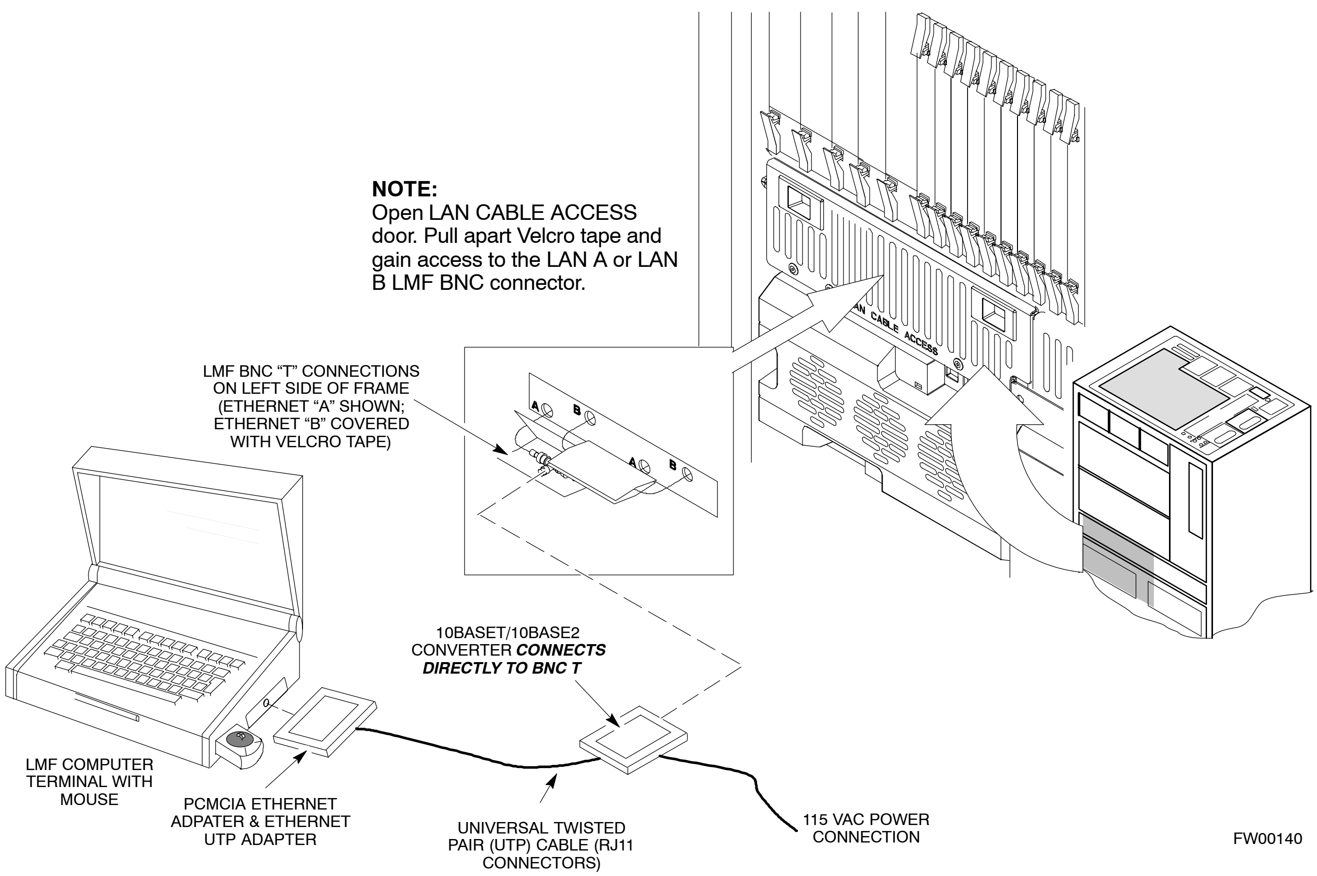
Connect the LMF to the BTS

The LMF is connected to the LAN A or B connector located on the left side of the frame's lower air intake grill, behind the LAN Cable Access door (see Figure 3-3).

Table 3-5: LMF to BTS Connection

Step	Action
1	To gain access to the connectors, open the LAN cable access door, then pull apart the fabric covering the BNC "T" connector (see Figure 3-3).
2	Connect the LMF to the LAN A BNC connector via PCMCIA Ethernet Adapter with an unshielded twisted–pair (UTP) Adapter and 10BaseT/10Base2 converter (powered by an external AC/DC transformer). If there is no login response, connect the LMF to the LAN B connector. If there is still no login response, see Table 6-1, Login Failure Troubleshooting Procedures.
	NOTE Xircom Model PE3–10B2 or equivalent can also be used to interface the LMF Ethernet connection to the frame connected to the PC parallel port, powered by an external AC/DC transformer. In this case, ***the BNC cable must not exceed 91 cm (3 ft) in length***.
	*** IMPORTANT** The LAN shield is isolated from chassis ground. The LAN shield (exposed portion of BNC connector) **must not touch the chassis** during optimization.

Figure 3-3: LMF Connection Detail



Using the LMF

Basic LMF Operation

LMF Coverage in This Publication – The LMF application program supports maintenance of both CDMA and SAS BTSs. All references to the LMF in this publication are to the CDMA portion of the program.

Operating Environments – The LMF application program allows the user to work in the two following operating environments which are accessed using the specified desktop icons:

- Graphical User Interface (GUI) using the **WinLMF** icon
- Command Line Interface (CLI) using the **WinLMF CDMA CLI** icon

The GUI is the *primary* optimization and acceptance testing operating environment. The CLI environment provides additional capability to the user to perform manually controlled acceptance tests and audit the results of optimization and calibration actions.

Basic Operation – Basic operation of the LMF in either environment includes performing the following:

- Selecting and deselecting BTS devices
- Enabling devices
- Disabling devices
- Resetting devices
- Obtaining device status

The following additional basic operation can be performed in a GUI environment:

- Sorting a status report window

For detailed information on performing these and other LMF operations, refer to the *LMF Help function on–line documentation*.

NOTE	*Unless otherwise noted*, LMF procedures in this manual are performed using the GUI environment.

The LMF Display and the BTS

BTS Display – When the LMF is logged into a BTS, a frame tab is displayed for each BTS frames. The frame tab will be labeled with "CDMA" and the BTS number, a dash, and the frame number (for example, **BTS–812–1** for BTS 812, RFMF 1). If there is only one frame for the BTS, there will only be one tab.

CDF/NECF Requirements – For the LMF to recognize the devices installed in the BTS, a BTS CDF/NECF file which includes equipage information for all the devices in the BTS must be located in the applicable **<*x*>:\<*lmf home directory*>\cdma\bts–#** folder. To provide the necessary channel assignment data for BTS operation, a CBSC CDF file which includes channel data for all BTS RFMFs is also required in the folder.

RFDS Display – If an RFDS is included in the CDF/NECF file, an **RFDS** tab labeled with "RFDS," a dash and the BTS number–frame number combination (for example, **RFDS–812–1**) will be displayed.

Graphical User Interface Overview

The LMF uses a GUI, which works in the following way:

- Select the device or devices.
- Select the action to apply to the selected device(s).
- While action is in progress, a status report window displays the action taking place and other status information.
- The status report window indicates when the the action is complete and displays other pertinent information.
- Clicking the **OK** button closes the status report window.

Understanding GUI Operation

The following screen captures are provided to help understand how the GUI operates:

– Figure 3-4 depicts the differences between packet and circuit CDMA "cdf" file identification. Note that if there is a packet version "bts" file, the "(P)" is added as a suffix. There is a corresponding "(C)" for the circuit mode version.

– Figure 3-5 depicts the Self-Managed Network Elements (NEs) state of a packet mode SC4812T. Note that an "X" is on the front of each card that is under Self–Managed Network Elements (NEs) control by the GLI3 card.

– Figure 3-6 depicts three of the available packet mode commands. Normally the GLI3 has Self-Managed Network Elements (NEs) control of all cards as shown in Figure 3-5 by an "(X)". In that state the LMF may only status a card. In order to download code or test a card, the LMF must request Self-Managed Network Elements (NEs) control of the card by using the shown dropdown menu. It also uses this menu to release control of the card back to the GLI3. The GLI3 will also assume control of the cards after the LMF logs out of the BTS. The packet mode GLI3 normally is loaded with a tape release and NECB and NECJ files which point to a tape release stored on the GLI3. When the GLI3 has control of a card it will maintain that card with the code on that tape release.

– Figure 3-7 depicts a packet mode site that has the MCC–1 and the BBX–1 cards under LMF control. Notice that the "X" is missing from the front of these two cards.

For detailed information on performing these and other LMF operations, refer to the *LMF Help function on–line documentation*.

Figure 3-4: BTS Login screen – identifying circuit and packet BTS files

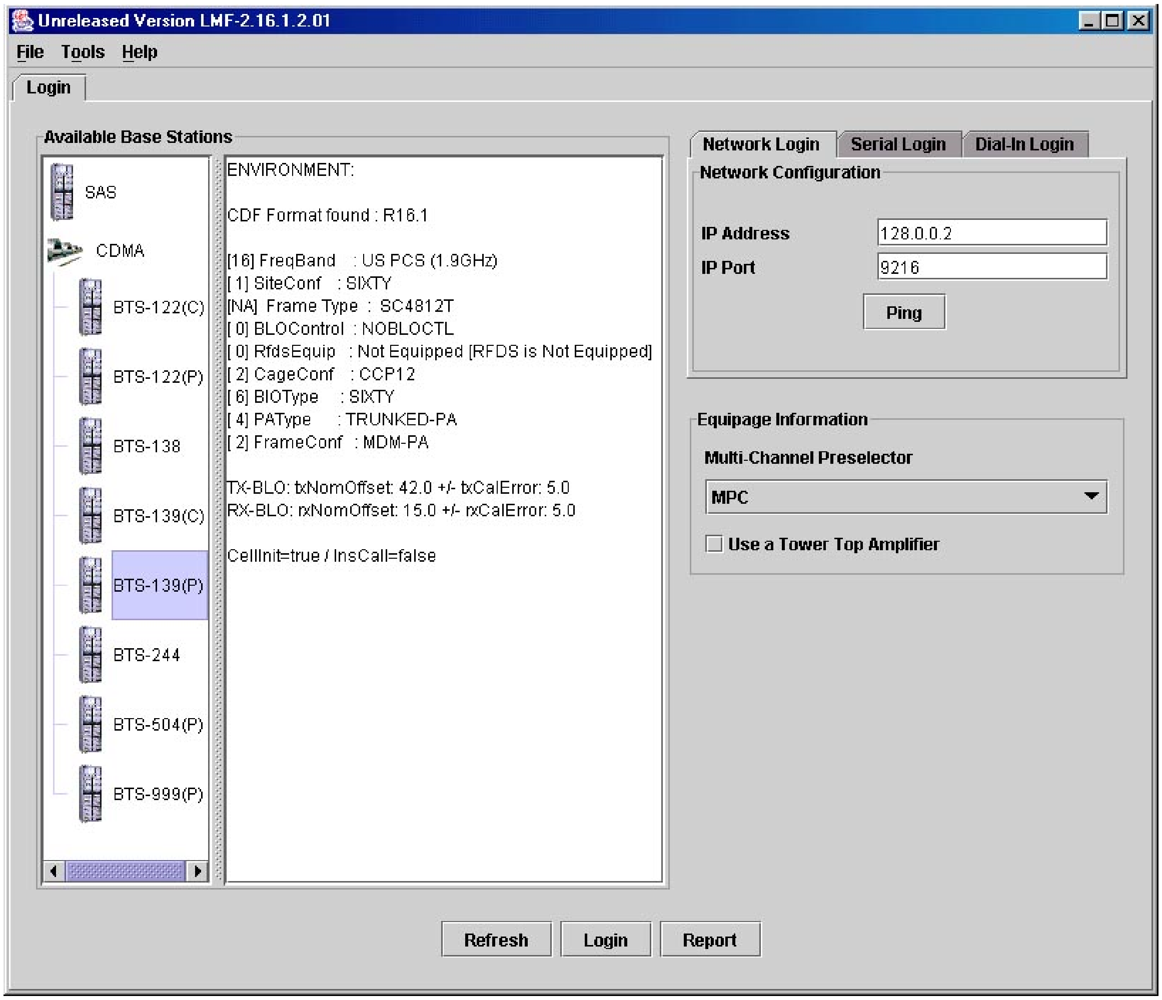


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Figure 3-5: Self–Managed Network Elements (NEs) state of a packet mode SC4812T

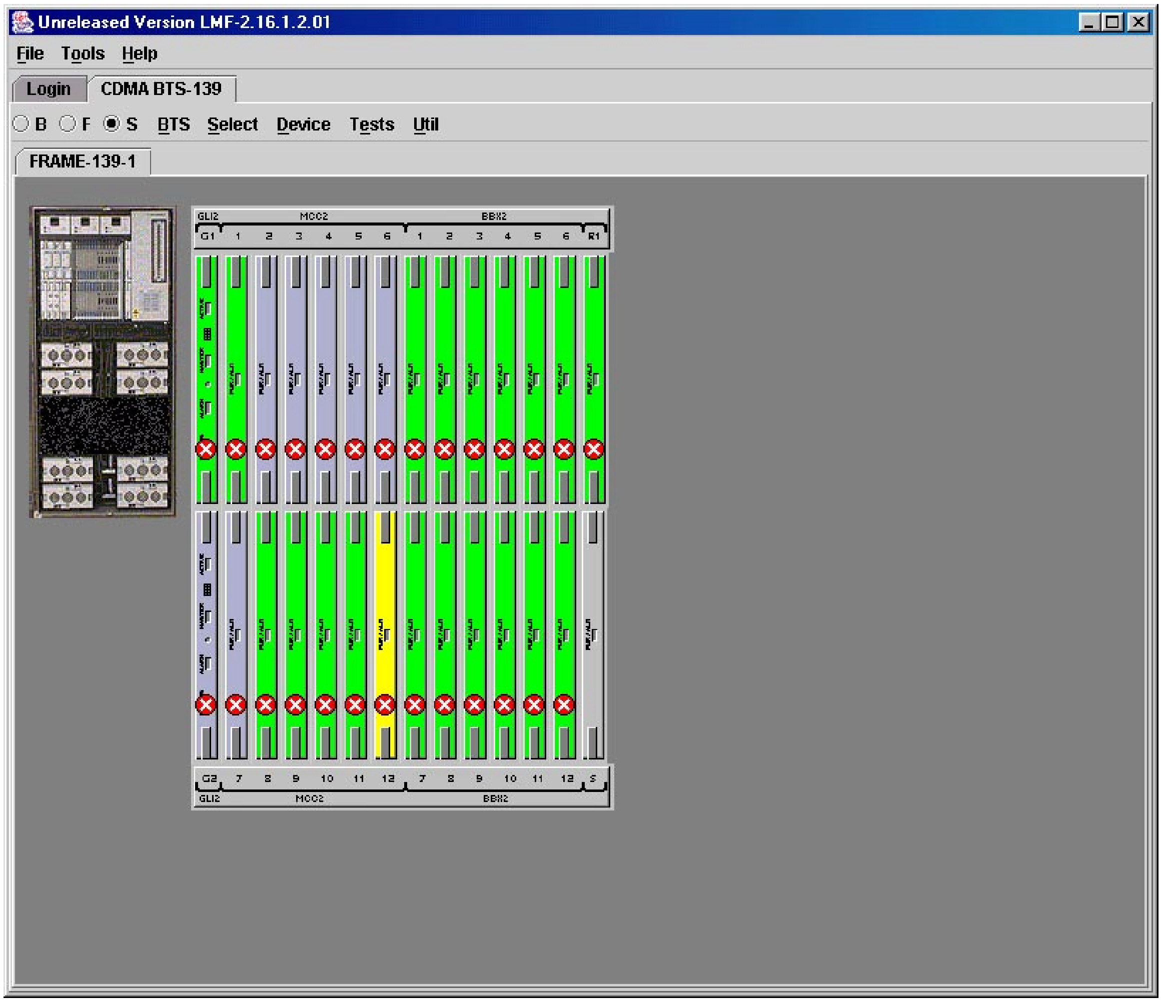


Figure 3-6: Available packet mode commands

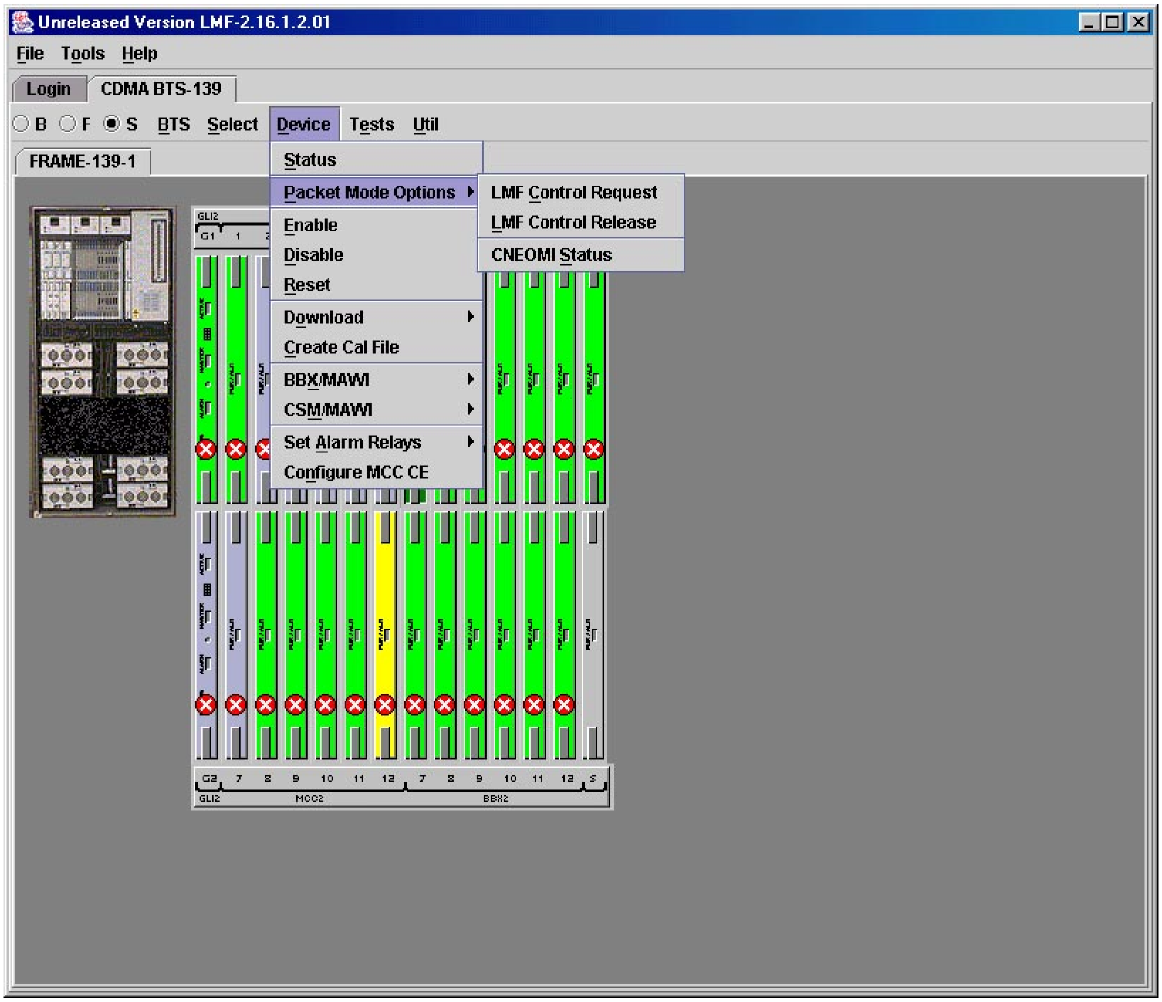
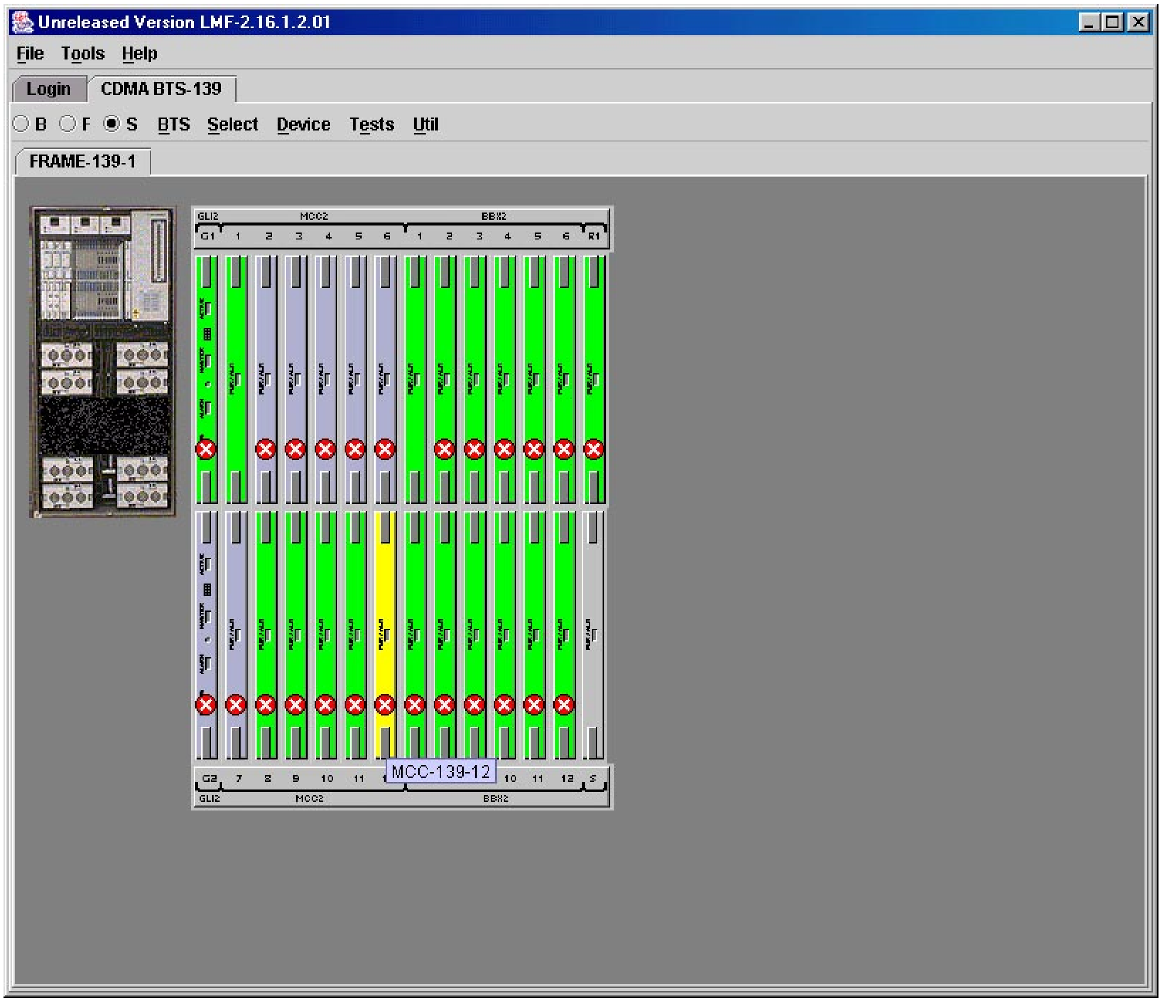


Figure 3-7: Packet mode site with MCC–1 and BBX–1 under LMF control



Command Line Interface Overview

The LMF also provides Command Line Interface (CLI) capability. Activate the CLI by clicking on a shortcut icon on the desktop. The CLI can not be launched from the GUI, only from the desktop icon.

Both the GUI and the CLI use a program known as the handler. Only one handler can be running at one time. Due to architectural limitations, the GUI must be started before the CLI if you want the GUI and CLI to use the same handler. When the CLI is launched after the GUI, the CLI automatically finds and uses an in–progress login session with a BTS initiated under the GUI. This allows the use of the GUI and the CLI in the same BTS login session. If a CLI handler is already running when the GUI is launched (this happens if the CLI window is already running when the user starts the GUI, or if another copy of the GUI is already running when the user starts the GUI), a dialog window displays the following warning message:


```
The CLI handler is already running.
This may cause conflicts with the LMF.
Are you sure you want to start the application?
           Yes       No
```

This window also contains **Yes** and **No** buttons. Selecting **Yes** starts the application. Selecting **No** terminates the application.

CLI Format Conventions

The CLI command syntax is as follows:

- verb
- device including device identifier parameters
- switch
- option parameters consisting of:
  - keywords
  - equals signs (=) between the keywords and the parameter values
  - parameter values

Spaces are required between the verb, device, switch, and option parameters. A hyphen is required between the device and its identifiers. Following is an example of a CLI command.

measure bbx–<bts_id>**–**<bbx_id> **rssi channel=6 sector=5**

Refer to *LMF CLI Commands* for a complete explanation of the CLI commands and their usage.

Logging into a BTS

Logging into a BTS establishes a communication link between the BTS and the LMF. An LMF session can be logged into only one BTS at a time.

Prerequisites

Before attempting to log into a BTS, ensure the following have been completed:

- The LMF is correctly installed on the LMF computer.
- A ***bts-nnn*** folder with the correct CDF/NECF and CBSC files exists.
- The LMF computer was connected to the BTS before starting the *Windows* operating system and the LMF software. If necessary, restart the computer after connecting it to the BTS in accordance with Table 3-5 and Figure 3-3.

CAUTION	Be sure that the correct **bts–#.cdf/necf** and **cbsc–#.cdf** file are used for the BTS. These should be the CDF/NECF files that are provided for the BTS by the CBSC. Failure to use the correct CDF/NECF files can result in invalid optimization. **Failure to use the correct CDF/NECF files to log into a live (traffic–carrying) site can shut down the site.**

BTS Login from the GUI Environment

Follow the procedure in Table 3-6 to log into a BTS when using the GUI environment.

Table 3-6: BTS GUI Login Procedure

✓	Step	Action

	1	Start the CDMA LMF GUI environment by double clicking on the WinLMF desktop icon (if the LMF is not running).
		NOTE
		If a warning similar to the following is displayed, select **No**, shut down other LMF sessions which may be running, and start the CDMA LMF GUI environment again:
		`The CLI handler is already running.`
		`This may cause conflicts with the LMF.`
		`Are you sure you want to start the application?`
		`Yes No`

	2	Click on the **Login** tab (if not displayed).
	3	If no base stations are displayed in the **Available Base Stations** pick list, double click on the **CDMA** icon.
	4	Click on the desired BTS number. For explanation of BTS numbering, see Figure 3-4.
	5	Click on the **Network Login** tab (if not already in the forefront).
	6	Enter the correct IP address (normally **128.0.0.2** for a field BTS) if not correctly displayed in the **IP Address** box.

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✓	Step	Action
		Table 3-6: BTS GUI Login Procedure
		NOTE 128.0.0.2 is the default IP address for MGLI–1 in field BTS units. 128.0.0.1 is the default IP address for MGLI–2.
	7	Type in the correct IP Port number (normally **9216**) if not correctly displayed in the **IP Port** box.

	8	Click on **Ping**.
		– If the connection is successful, the **Ping Display** window shows text similar to the following:
		`Reply from 128 128.0.0.2: bytes=32 time=3ms TTL=255`
		– If there is no response the following is displayed:
		`128.0.0.2:9216:Timed out`
		If the MGLI fails to respond, reset and perform the ping process again. If the MGLI still fails to respond, typical problems are shorted BNC to inter–frame cabling, open cables, crossed A and B link cables, missing 50–Ohm terminators, or the MGLI itself.

	9	Change the **Multi-Channel Preselector** (from the **Multi-Channel Preselector** pick list), normally **MPC,** corresponding to your BTS configuration, if required.
		NOTE When performing RX tests on expansion frames, do not choose EMPC if the test equipment is connected to the starter frame.
	10	Click on the **Use a Tower Top Amplifier**, if applicable.
	11	Click on **Login**. (A BTS tab with the BTS and frame numbers is displayed.)
		NOTE • If you attempt to login to a BTS that is already logged on, all devices will be gray. • There may be instances where the BTS initiates a log out due to a system error (i.e., a device failure). • If the MGLI is OOS_ROM (blue), it will have to be downloaded with code before other devices can be seen. • If the MGLI is OOS–RAM (yellow), it must be enabled before other installed devices can be seen.

BTS Login from the CLI Environment

Follow the procedure in Table 3-7 to log into a BTS when using the CLI environment.

NOTE	If the CLI and GUI environments are to be used at the same time, the *GUI must be started first and BTS login must be performed from the GUI*. Refer to Table 3-6 to start the GUI environment and log into a BTS.

Table 3-7: BTS CLI Login Procedure

✓	Step	Action
	1	Double–click the WinLMF CLI desktop icon (if the LMF CLI environment is not already running).
		NOTE If a BTS was logged into under a GUI session before the CLI environment was started, the CLI session will be logged into the same BTS, and Step 2 is not required.

	2	At the `/wlmf` prompt, enter the following command:
		login bts–<*bts#*> **host=**<*host*> **port=**<*port*>
		where:
		host = MGLI card IP address (defaults to address last logged into for this BTS or 128.0.0.2 if this is first login to this BTS)
		port = IP port of the BTS (defaults to port last logged into for this BTS or 9216 if this is first login to this BTS)
		A response similar to the following will be displayed:
		`LMF>`
		`13:08:18.882 Command Received and Accepted`
		`COMMAND=login bts–33`
		
		`13:08:18.882 Command In Progress`
		
		`13:08:21.275 Command Successfully Completed`
		`REASON_CODE=”No Reason”`

Logging Out

Logging out of a BTS is accomplished differently for the GUI and CLI operating environments.

NOTE	The GUI and CLI environments use the same connection to a BTS. If a GUI and the CLI session are running for the same BTS at the same time, logging out of the BTS in either environment will log out of it for both. When either a login or logout is performed in the CLI window, there is no GUI indication that the login or logout has occurred.

Logging Out of a BTS from the GUI Environment

Follow the procedure in Table 3-8 to logout of a BTS when using the GUI environment.

Table 3-8: BTS GUI Logout Procedure

✓	Step	Action
	1	Click on **BTS** on the BTS tab menu bar.
	2	Click the **Logout** item in the pull–down menu (a **Confirm Logout** pop–up message will appear).
	3	Click on **Yes** or press the **<Enter>** key to confirm logout. The **Login** tab will appear. **NOTE** If a logout was previously performed on the BTS from a CLI window running at the same time as the GUI, a **Logout Error** pop–up message appears stating the system should not log out of the BTS. When this occurs, the GUI must be exited and restarted before it can be used for further operations.
	4	If a **Logout Error** pop–up message appears stating that the system could not log out of the Base Station because the given BTS is not logged in, click **OK** and proceed to Step 5.
	5	Select **File > Exit** in the window menu bar, click **Yes** in the **Confirm Logout** pop–up, and click **OK** in the **Logout Error** pop–up which appears again.
	6	If further work is to be done in the GUI, restart it.
		NOTE • The **Logout** item on the BTS menu bar will only log you out of the displayed BTS. • You can also log out of all BTS sessions and exit LMF by clicking on the **File** selection in the menu bar and selecting **Exit** from the **File** menu list. A **Confirm Logout** pop–up message will appear.

Logging Out of a BTS from the CLI Environment

Follow the procedure in Table 3-9 to logout of a BTS when using the CLI environment.

Table 3-9: BTS CLI Logout Procedure

✓	Step	Action
		NOTE If the BTS is also logged into from a GUI running at the same time and further work must be done with it in the GUI, proceed to Step 2.

	1	Log out of a BTS by entering the following command:
		logout bts–<bts#>
		A response similar to the following will be displayed:
		`LMF>`
		`13:24:51.028  Command Received and Accepted`
		`              COMMAND=logout bts–33`
		`13:24:51.028  Command In Progress`
		`13:24:52.04   Command Successfully Completed`
		`              REASON_CODE="No Reason"`

	2	If desired, close the CLI interface by entering the following command: **exit** A response similar to the following will be displayed before the window closes: `Killing background processes....`

Establishing an MMI Communication Session

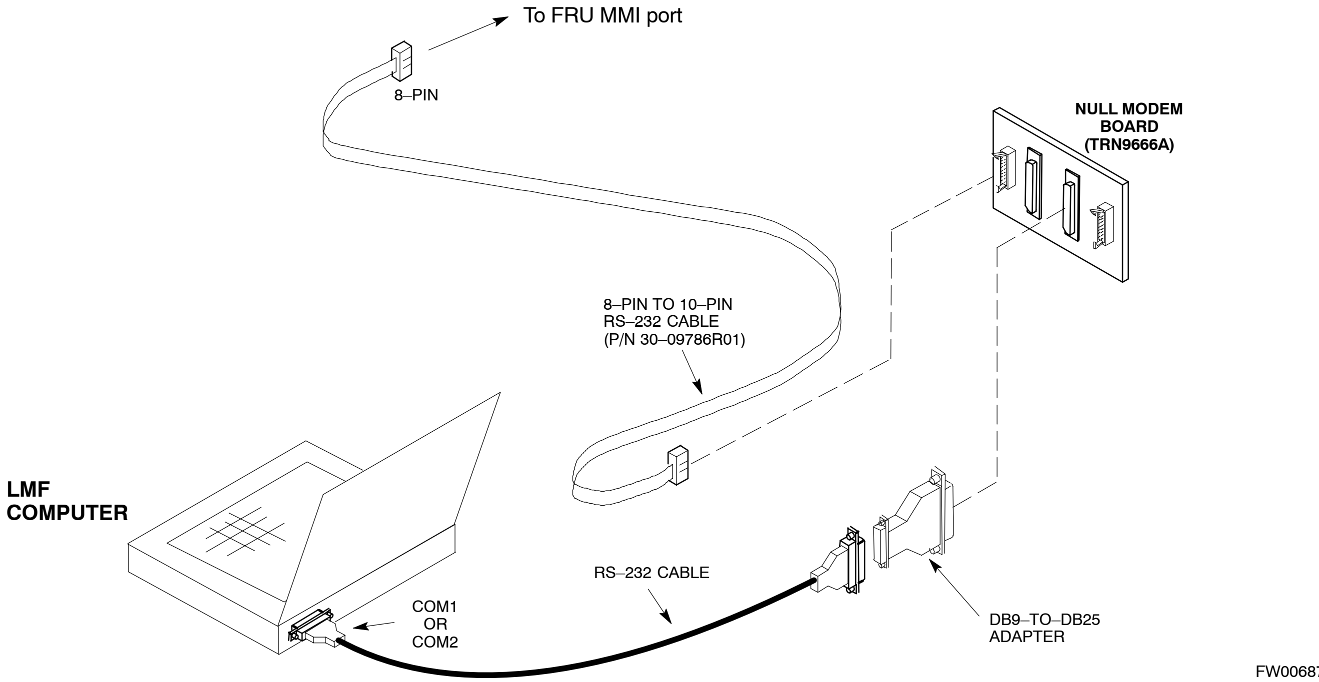
Equipment Connection – Figure 3-8 illustrates common equipment connections for the LMF computer. For specific connection locations on FRUs, refer to the illustration accompanying the procedures which require the MMI communication session.

Initiate MMI Communication – For those procedures which require MMI communication between the LMF and BTS FRUs, follow the procedures in Table 3-10 to initiate the communication session.

Table 3-10: Establishing MMI Communications

Step	Action
1	Connect the LMF computer to the equipment as detailed in the applicable procedure that requires the MMI communication session.
2	If the LMF computer has only one serial port (COM1) and the LMF is running, disconnect the LMF from COM1 by performing the following:
2a	– Click on **Tools** in the LMF window menu bar, and select **Options** from the pull–down menu list. — An **LMF Options** dialog box will appear.
2b	– In the **LMF Options** dialog box, click the **Disconnect Port** button on the **Serial Connection** tab.
3	Start the named HyperTerminal connection for MMI sessions by double clicking on its *Windows* desktop shortcut. **NOTE** If a *Windows* desktop shortcut was not created for the MMI connection, access the connection from the *Windows* Start menu by selecting: **Programs > Accessories > Hyperterminal > HyperTerminal > <*Named HyperTerminal Connection (e.g., MMI Session)*>**
4	Once the connection window opens, establish MMI communication with the BTS FRU by pressing the LMF computer **<Enter>** key until the prompt identified in the applicable procedure is obtained.

Figure 3-8: CDMA LMF Computer Common MMI Connections



Online Help

Task oriented online help is available in the LMF by clicking on **Help** in the window menu bar, and selecting **LMF Help** from the pull–down menu.

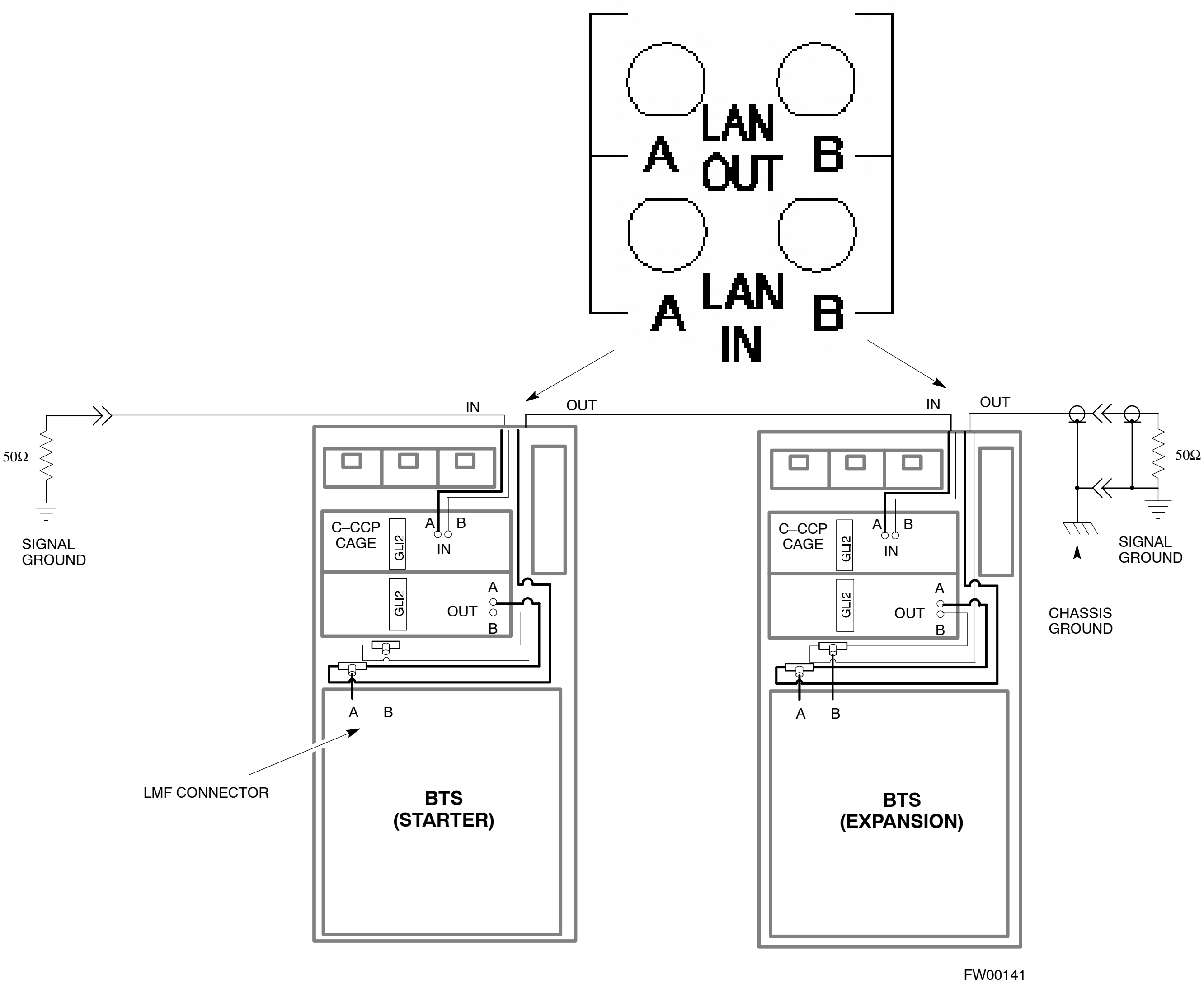
Pinging the Processors

Pinging the BTS

For proper operation, the integrity of the Ethernet LAN A and B links must be be verified. Figure 3-9 represents a typical BTS Ethernet configuration. The drawing depicts one link (of two identical links), A and B.

Ping is a program that routes request packets to the LAN network modules to obtain a response from the specified "targeted" BTS.

Figure 3-9: BTS Ethernet LAN Interconnect Diagram



Follow the procedure in Table 3-11 and refer to Figure 3-9 as required to ping each processor (on both LAN A and LAN B) and verify LAN redundancy is operating correctly.

CAUTION	Always wear a conductive, high impedance wrist strap while handling any circuit card/module to prevent damage by ESD.

NOTE	**IMPORTANT:** The Ethernet LAN A and B cables must be installed on each frame/enclosure before performing this test. All other processor board LAN connections are made via the backplanes.

3

Table 3-11: Pinging the Processors

✓	Step	Action
	1	If you have not already done so, connect the LMF to the BTS (see Table 3-5 on page 3-17).
	2	From the Windows desktop, click the **Start** button and select **Run.**
	3	In the **Open** box, type **ping** and the `<MGLI IP address>` (*fo*r example, **ping 128.0.0.2**). **NOTE** 128.0.0.2 is the default IP address for MGLI–1 in field BTS units. 128.0.0.1 is the default IP address for MGLI–2.
	4	Click on the **OK** button.

	5	If the connection is successful, text similar to the following is displayed:
		`Reply from 128 128.0.0.2: bytes=32 time=3ms TTL=255`
		If there is no response the following is displayed:
		`Request timed out`
		If the MGLI fails to respond, reset and perform the ping process again. If the MGLI still fails to respond, typical problems are shorted BNC to inter-frame cabling, open cables, crossed A and B link cables, missing 50–Ohm terminators, or the MGLI itself.

Download the BTS

Overview

Before a BTS can operate, each equipped device must contain device initialization (ROM) code. ROM code is loaded in all devices during manufacture or factory repair, or, for software upgrades, from the CBSC using the DownLoad Manager (DLM). Device application (RAM) code and data must be downloaded to each equipped device by the user before the BTS can be made fully functional for the site where it is installed.

ROM Code

Downloading ROM code to BTS devices from the LMF is *NOT routine maintenance nor a normal part of the optimization process.* It is only done in unusual situations where the resident ROM code in the device does not match the release level of the site operating software *AND* the CBSC cannot communicate with the BTS to perform the download.

If you must download ROM code, the procedures are located in **Appendix G.**

Before ROM code can be downloaded from the LMF, the correct ROM code file for each device to be loaded must exist on the LMF computer. ROM code *must be manually selected* for download.

NOTE	The ROM code file is not available for GLI3s. GLI3s are ROM code loaded at the factory.

ROM code can be downloaded to a device that is in any state. After the download is started, the device being downloaded will change to OOS_ROM (blue). The device will remain OOS_ROM (blue) when the download is completed. A *compatible revision–level* RAM code must then be downloaded to the device. Compatible code loads for ROM and RAM must be used for the device type to ensure proper performance. The compatible device code release levels for the BSS software release being used are listed in the Version Matrix section of the SC™ CDMA Release Notes (supplied on the tape or CD–ROM containing the BSS software).

RAM Code

Before RAM code can be downloaded from the LMF, the correct RAM code file for each device must exist on the LMF computer. RAM code can be automatically or manually selected depending on the **Device** menu item chosen and where the RAM code file for the device is stored in the LMF file structure. The RAM code file will be selected automatically if the file is in the ***<x>:\<lmf home directory>****\cdma\loads\n.n.n.n\code* folder (where *n.n.n.n* is the download code version number that matches the “NextLoad” parameter of the CDF file). The RAM code file in the code folder must have the correct hardware bin number for the device to be loaded.

RAM code can be downloaded to a device that is in any state. After the download is started, the device being downloaded changes to OOS-ROM (blue). When the download is completed successfully, the device will change to OOS-RAM (yellow).

When code is downloaded to an MGLI or GLI, the LMF automatically also downloads data and then enables the MGLI. When enabled, the MGLI will change to INS_ACT (bright green). A redundant GLI will not be automatically enabled and will remain OOS_RAM (yellow). When the redundant GLI is manually commanded to enable through the LMF, it will change state to INS_SBY (olive green).

For non–MGLI devices, data must be downloaded after RAM code is downloaded. To download data, the device state must be OOS–RAM (yellow).

The devices to be loaded with RAM code and data are:

- Master Group Line Interface (MGLI2 or MGLI3)
- Redundant GLI (GLI2 or GLI3)
- Clock Synchronization Module (CSM) (*Only if new revision code must be loaded*)
- Multi Channel Card (MCC24E, MCC8E or MCC–1X)
- Broadband Transceiver (BBX2 or BBX–1X)
- Test Subscriber Interface Card (TSIC) – if RFDS is installed

NOTE	The MGLI *must* be successfully downloaded with code and data, and put INS *before* downloading any other device. The download code process for an MGLI automatically downloads data and enables the MGLI before downloading other devices. The other devices can be downloaded in any order.

Verify GLI ROM Code Loads

Devices should not be loaded with a RAM code version which is not compatible with the ROM code with which they are loaded. Before downloading RAM code and data to the processor cards, follow the procedure in Table 3-12 to verify the GLI devices are loaded with the correct ROM code for the software release used by the BSS.

Prerequisite

Identify the correct GLI ROM code load for the software release being used on the BSS by referring to the Version Matrix section of the SC™ CDMA Release Notes (supplied on the tapes or CD–ROMs containing the BSS software).

Table 3-12: Verify GLI ROM Code Loads

Step	Action
1	***If it has not already been done***, start a *GUI* LMF session and log into the BTS (refer to Table 3-6).
2	Select all GLI devices by clicking on them, and select **Device > Status** from the BTS menu bar.
3	In the status report window which opens, note the number in the **ROM Ver** column for each GLI.
4	If the ROM code loaded in the GLIs is *not* the correct one for the software release being used on the BSS, perform the following:
4a	– Log out of the BTS as described in Table 3-8 or Table 3-9, as applicable.
4b	– Disconnect the LMF computer.
4c	– Reconnect the span lines as described in Table 5-7.
4d	– Have the CBSC download the correct ROM code version to the BTS devices.
5	When the GLIs have the correct ROM load for the software release being used, be sure the span lines are disabled as outlined in Table 3-4 and proceed to downloading RAM code and data.

3

Download RAM Code and Data to MGLI and GLI

Follow the procedure in Table 3-13 to download the firmware application code for the MGLI. The download code action downloads data and also enables the MGLI.

Prerequisite

- Prior to performing this procedure, ensure a code file exists for each of the devices to be loaded.
- The LMF computer is connected to the BTS (refer to Table 3-5), and is logged in using the *GUI* environment (refer to Table 3-6).

Table 3-13: Download and Enable MGLI

✓	Step	Action
	1	Be sure the LMF will use the correct software release for code and data downloads by performing the following steps:
	1a	– Click on **Tools** in the LMF menu bar, and select **Update NextLoad > CDMA** from the pull–down menus.
	1b	– Click on the BTS to be loaded. — The BTS will be highlighted.
	1c	– Click the button next to the correct code version for the software release being used. — A black dot will appear in the button circle.
	1d	– Click **Save.**
	1e	– Click **OK** to close each of the advisory boxes which appear.
	2	Prepare to download code to the MGLI by clicking on the device.
	3	Click **Device** in the BTS menu bar, and select **Download > Code/Data** in the pull–down menus. – A status report is displayed confirmimg change in the device(s) status.
	4	Click **OK** to close the status window. – The MGLI will automatically be downloaded with data and enabled.
	5	Once the MGLI is enabled, load and enable additional installed GLIs by clicking on the devices and repeating Steps 3 and 4.
	6	Click **OK** to close the status window for the additional GLI devices.

Download Code and Data to Non–GLI Devices

Downloads to non–GLI devices can be performed individually for each device or all equipped devices can be downloaded with one action.

NOTE

– When downloading multiple devices, the download may fail for some of the devices (a time out occurs). These devices can be downloaded separately after completing the multiple download.

– CSM devices are RAM code–loaded at the factory. RAM code is downloaded to CSMs only if updating to a newer software version.

Follow the procedure in Table 3-14 to download RAM code and data to non–GLI devices.

Table 3-14: Download RAM Code and Data to Non–GLI Devices

✓	Step	Action
	1	Select the target CSM, MCC, and/or BBX device(s) by clicking on them.
	2	Click **Device** in the BTS menu bar, and select **Download > Code/Data** in the pull–down menus. – A status report displays the result of the download for each selected device.
	3	Click **OK** to close the status report window when downloading is completed.
		NOTE After a BBX, CSM or MCC is successfully downloaded with code and has changed to OOS-RAM, the status LED should be rapidly flashing GREEN.
		NOTE The command in Step 2 loads both code and data. Data can be downloaded without doing a code download anytime a device is OOS–RAM using the command in Step 4.
	4	To download just the firmware application data to each device, select the target device and select: **Device>Download>Data**

BBX Cards Remain OOS_ROM

If BBX cards remain OOS_ROM (blue) after power–up or following code load, refer to Table 6-4, steps 9 and 10.

Select CSM Clock Source

CSMs must be enabled prior to enabling the MCCs. Procedures in the following two sub-sections cover the actions to accomplish this. For additional information on the CSM sub–system, see “Clock Synchronization Manager (CSM) Sub–system Description” in the CSM System Time – GPS & LFR/HSO Verification section of this chapter.

Select CSM Clock Source

A CSM can have three different clock sources. The **Clock Source** function can be used to select the clock source for each of the three inputs. This function is only used if the clock source for a CSM needs to be changed. The **Clock Source** function provides the following clock source options:

- Local GPS
- Mate GPS
- Remote GPS
- HSO (only for sources 2 & 3)
- HSO Extender
- HSOX (only for sources 2 & 3)
- LFR (only for sources 2 & 3)
- 10 MHz (only for sources 2 & 3)
- NONE (only for sources 2 & 3)

Prerequisites

- MGLI is INS_ACT (bright green)
- CSM is OOS_RAM (yellow) or INS_ACT (bright green)

Follow the procedure in Table 3-15 to select a CSM Clock Source.

Table 3-15: Select CSM Clock Source

✓	Step	Action
	1	Select the applicable CSM(s) for which the clock source is to be selected.
	2	Click on **Device** in the BTS menu bar, and select **CSM/MAWI > Select Clock Source...** in the pull–down menu list. – A CSM clock reference source selection window will appear.
	3	Select the applicable clock source in the **Clock Reference Source** pick lists. Uncheck the related check boxes for Clock Reference Sources 2 and 3 if you do not want the displayed pick list item to be used.
	4	Click on the **OK** button. – A status report is displayed showing the results of the operation.
	5	Click on the **OK** button to close the status report window.

NOTE	For non–RGPS sites only, verify the CSM configured with the GPS receiver “daughter board” is installed in the CSM–1 slot before continuing.

Enable CSMs

NOTE	
	– CSMs are code loaded at the factory. This data is retained in EEPROM. The download code procedure is required in the event it becomes necessary to code load CSMs with updated software versions. Use the status function to determine the current code load versions. – The CSM(s) to be enabled must have been downloaded with code (Yellow, OOS–RAM) and data.

Each BTS CSM system features two CSM boards per site. In a typical operation, the primary CSM locks its Digital Phase Locked Loop (DPLL) circuits to GPS signals. These signals are generated by either an on–board GPS module (RF–GPS) or a remote GPS receiver (R–GPS). The CSM2 card is required when using the R–GPS. The GPS receiver (mounted on CSM–1) is the primary timing reference and synchronizes the entire cellular system. CSM–2 provides redundancy but does not have a GPS receiver.

The BTS may be equipped with a remote GPS, LORAN–C LFR, HSO 10 MHz Rubidium source, or HSOX for expansion frames, which the CSM can use as a secondary timing reference. In all cases, the CSM monitors and determines what reference to use at a given time.

Follow the procedure in Table 3-16 to enable the CSMs.

Table 3-16: Enable CSMs

✓	Step	Action
	1	Click on the target CSM (**CSM–2 first, if equipped with two CSMs**).
	2	From the **Device** pull down, select **Enable**. – A status report is displayed confirming change in the device(s) status. – Click **OK** to close the status report window.
		NOTE – The board in slot CSM 1 interfaces with the GPS receiver. The enable sequence for this board can take up to ***one hour*** (see below). – FAIL may be shown in the status report table for a slot CSM 1 enable action. If Waiting For Phase Lock is shown in the Description field, the CSM changes to the Enabled state after phase lock is achieved.
		*** IMPORTANT** – The GPS satellite system satellites are not in a geosynchronous orbit and are maintained and operated by the United States Department of Defense (D.O.D.). The D.O.D. periodically alters satellite orbits; therefore, satellite trajectories are subject to change. A GPS receiver that is INS contains an “almanac” that is updated periodically to take these changes into account. – If a GPS receiver has not been updated for a number of weeks, it may take up to an hour for the GPS receiver “almanac” to be updated. – Once updated, the GPS receiver must track at least four satellites and obtain (hold) a 3–D position fix for a minimum of 45 seconds before the CSM will come in service. (In some cases, the GPS receiver needs to track only one satellite, depending on accuracy mode set during the data load).

. . . continued on next page

Table 3-16: Enable CSMs		
✓	Step	Action
		NOTE – If equipped with two CSMs, CSM–1 should be bright green (INS–ACT) and CSM–2 should be dark green (INS–STY) – After the CSMs have been successfully enabled, observe the PWR/ALM LEDs are steady green (alternating green/red indicates the card is in an alarm state).
	3	If more than an hour has passed, refer to CSM Verification, see Figure 3-11 and Table 3-20 to determine the cause.

3

Enable MCCs

Follow the procedure in Table 3-17 to enable the MCCs.

NOTE	The MGLI and primary CSM must be downloaded and enabled (IN–SERVICE ACTIVE) before downloading and enabling the MCC.

Table 3-17: Enable MCCs		
✓	Step	Action
	1	Select the MCCs to be enabled or from the **Select** pull–down menu choose **MCCs**.
	2	Click on **Device** in the BTS menu bar, and select **Enable** in the pull–down menu list. – A status report is displayed showing the results of the enable operation.
	3	Click on **OK** to close the status report window.

Enable Redundant GLIs

Follow the procedure in Table 3-18 to enable the redundant GLI(s).

Table 3-18: Enable Redundant GLIs		
✓	Step	Action
	1	Select the target redundant GLI(s).
	2	From the **Device** menu, select **Enable**. – A status report window confirms the change in the device(s) status and the enabled GLI(s) is green.
	3	Click on **OK** to close the status report window.

CSM System Time – GPS & LFR/HSO Verification

CSM & LFR Background

The primary function of the Clock Synchronization Manager (CSM) boards (slots 1 and 2) is to maintain CDMA system time. The CSM in slot 1 is the primary timing source while slot 2 provides redundancy. The CSM2 card (CSM second generation) is required when using the remote GPS receiver (R–GPS). R–GPS uses a GPS receiver in the antenna head that has a digital output to the CSM2 card. CSM2 can have a daughter card as a local GPS receiver to support an RF–GPS signal.

The CSM2 switches between the primary and redundant units (slots 1 and 2) upon failure or command. CDMA Clock Distribution Cards (CCDs) buffer and distribute even–second reference and 19.6608 MHz clocks. CCD–1 is married to CSM–1 and CCD–2 is married to CSM 2. A failure on CSM–1 or CCD–1 cause the system to switch to redundant CSM–2 and CCD–2.

In a typical operation, the primary CSM locks its Digital Phase Locked Loop (DPLL) circuits to GPS signals. These signals are generated by either an on–board GPS module (RF–GPS) or a remote GPS receiver (R–GPS). The CSM2 card is required when using the R–GPS. DPLL circuits employed by the CSM provide switching between the primary and redundant unit upon request. Synchronization between the primary and redundant CSM cards, as well as the LFR or HSO back–up source, provides excellent reliability and performance.

Each CSM board features an ovenized, crystal oscillator that provides 19.6608 MHz clock, even second tick reference, and 3 MHz sinewave reference, referenced to the selected synchronization source (GPS, LORAN–C Frequency Receiver (LFR), or High Stability Oscillator (HSO), T1 Span, or external reference oscillator sources).

The 3 MHz signals are also routed to the RDM EXP 1A & 1B connectors on the top interconnect panel for distribution to co–located frames at the site.

Fault management has the capability of switching between the GPS synchronization source and the LFR/HSO backup source in the event of a GPS receiver failure on CSM–1. During normal operation, the CSM–1 board selects GPS as the primary source (see Table 3-20). The source selection can also be overridden via the LMF or by the system software.

Front Panel LEDs

The status of the LEDs on the CSM boards are as follows:

- Steady Green – Master CSM locked to GPS or LFR (INS).
- Rapidly Flashing Green – Standby CSM locked to GPS or LFR (STBY).
- Flashing Green/Rapidly Flashing Red – CSM OOS–RAM attempting to lock on GPS signal.
- Rapidly Flashing Green and Red – Alarm condition exists. Trouble Notifications (TNs) are currently being reported to the GLI.

Low Frequency Receiver/High Stability Oscillator (LFR/HSO)

The CSM and the LFR/HSO – The CSM performs the overall configuration and status monitoring functions for the LFR/HSO. In the event of GPS failure, the LFR/HSO is capable of maintaining synchronization initially established by the GPS reference signal.

LFR – The LFR requires an active external antenna to receive LORAN–C RF signals. Timing pulses are derived from this signal, which is synchronized to Universal Time Coordinates (UTC) and GPS time. The LFR can maintain system time indefinitely after initial GPS lock.

HSO – The HSO is a high stability 10 MHz oscillator with the necessary interface to the CSMs. The HSO is typically installed in those geographical areas not covered by the LORAN–C system. Since the HSO is a free–standing oscillator, system time can only be maintained for 24 hours after 24 hours of GPS lock

Upgrades and Expansions: LFR2/HSO2/HSOX

LFR2/HSO2 (second generation cards) both export a timing signal to the expansion or logical BTS frames. The associated expansion or logical frames require an HSO–expansion (HSOX) whether the starter frame has an LFR2 or an HSO2. The HSOX accepts input from the starter frame and interfaces with the CSM cards in the expansion frame. LFR and LFR2 use the same source code in source selection (see Table 3-19). HSO, HSO2, and HSOX use the same source code in source selection (see Table 3-19).

NOTE	Allow the **base site and test equipment to warm up for 60 minutes** after any interruption in oscillator power. CSM board warm-up allows the oscillator oven temperature and oscillator frequency to stabilize prior to test. Test equipment warm-up allows the Rubidium standard timebase to stabilize in frequency before any measurements are made.

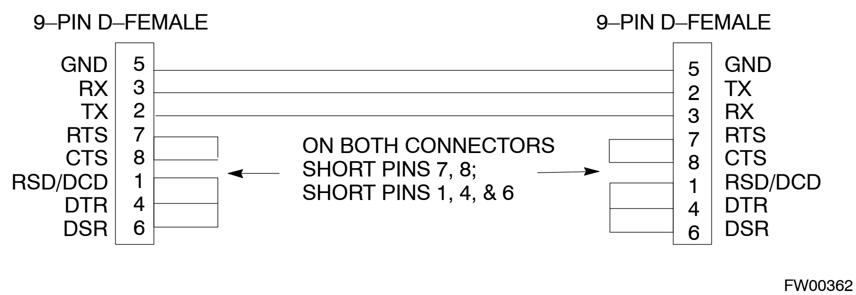
CSM Frequency Verification

The objective of this procedure is the initial verification of the CSM boards before performing the RF path verification tests. Parts of this procedure will be repeated for final verification *after* the overall optimization has been completed.

Null Modem Cable

A null modem cable is required. It is connected between the MMI port of the primary CSM and the null modem board. Figure 3-10 shows the wiring detail for the null modem cable.

Figure 3-10: Null Modem Cable Detail



Prerequisites

Ensure the following prerequisites have been met before proceeding:

- The LMF is **NOT** logged into the BTS.
- The COM1 port is connected to the MMI port of the primary CSM via a null modem board.

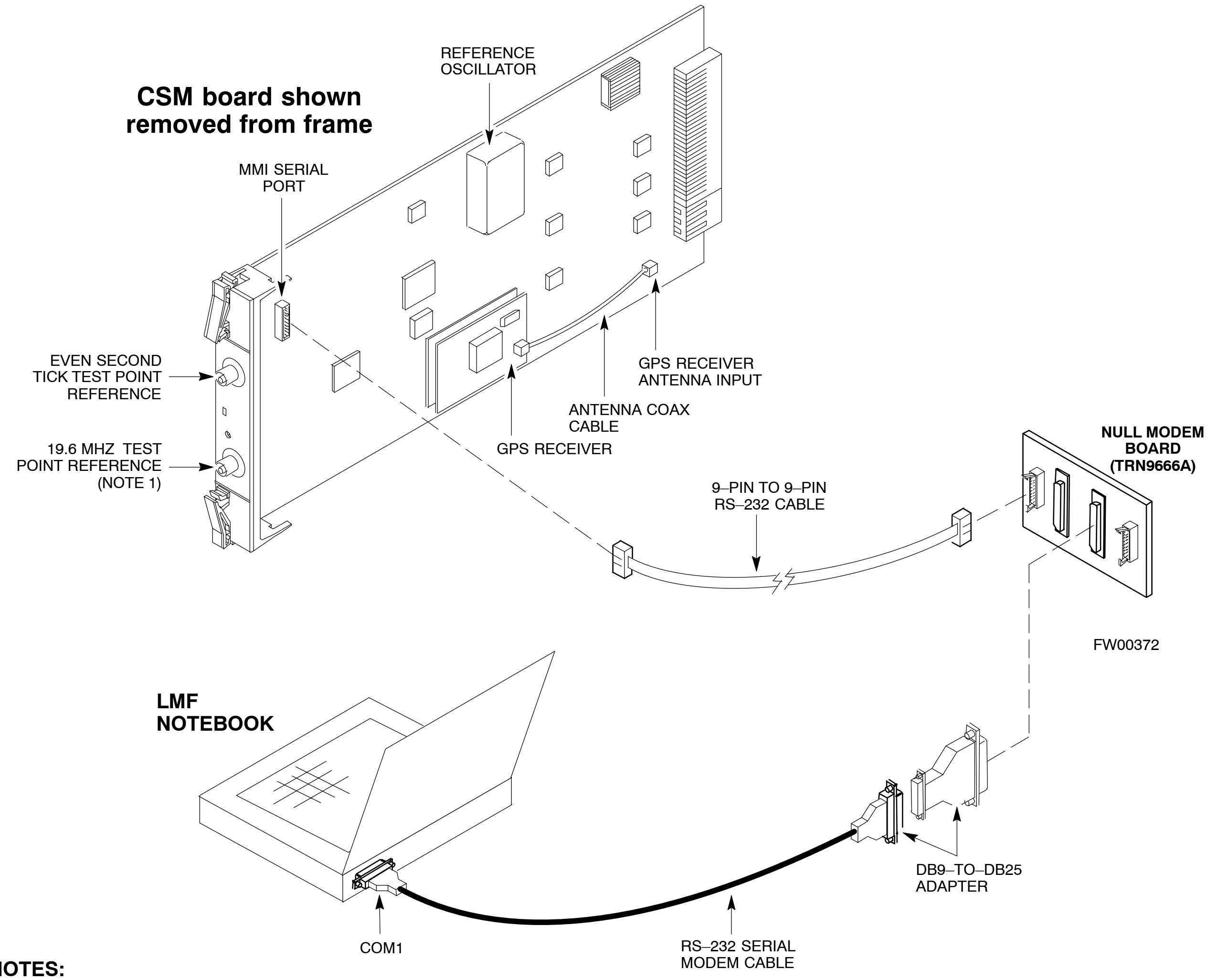
Test Equipment Setup: GPS & LFR/HSO Verification

Follow the procedure in Table 3-19 to set up test equipment while referring to Figure 3-11 as required.

Table 3-19: Test Equipment Setup (GPS & LFR/HSO Verification)

Step	Action
1	Perform one of the following operations: • For **local GPS** (RF–GPS), verify a CSM board with a GPS receiver is installed in primary CSM slot 1 and that CSM–1 is INS. This is verified by checking the board ejectors for kit number **SGLN1145** on the board in slot 1. • For **Remote GPS** (RGPS), verify a CSM2 board is installed in primary slot 1 and that CSM–1 is INS. This is verified by checking the board ejectors for kit number **SGLN4132ED** (or later).
2	Remove CSM–2 (if installed) and connect a serial cable from the LMF COM 1 port (via null modem board) to the MMI port on CSM–1.
3	Reinstall CSM–2.
4	Start an MMI communication session with CSM–1 by using the Windows desktop shortcut icon (see Table 3-3) **NOTE** The LMF program must not be running when a Hyperterminal session is started if COM1 is being used for the MMI session.
5	When the terminal screen appears, press the **<Enter>** key until the **CSM>** prompt appears.

Figure 3-11: CSM MMI terminal connection



NOTES:
1. One LED on each CSM:
   Green = IN–SERVICE ACTIVE
   Fast Flashing Green = OOS–RAM
   Red = Fault Condition
   Flashing Green & Red = Fault

3

GPS Initialization/Verification

Follow the procedure in Table 3-20 to initialize and verify proper GPS receiver operation.

Prerequisites

Ensure the following prerequisites have been met before proceeding:

- The LMF is not logged into the BTS.
- The COM1 port is connected to the MMI port of the primary CSM via a null modem board (see Figure 3-11).
- The primary CSM and HSO (if equipped) have been warmed up for at least 15 minutes.

CAUTION	Connect the GPS antenna to the GPS RF connector **ONLY**. Damage to the GPS *antenna* and/or *receiver* can result if the GPS antenna is inadvertently connected to any other RF connector.

Table 3-20: GPS Initialization/Verification

Step	Action

1	To verify that `Clock alarms (0000)`, `Dpll is locked and has a reference source`, and `GPS self test passed` messages are displayed within the report, issue the following MMI command
	bstatus
	– Observe the following typical response:
	`Clock Alarms (0000):`
	
	`DPLL is locked and has a reference source.`
	`GPS receiver self test result: passed`
	
	`Time since reset 0:33:11, time since power on: 0:33:11`

2	Enter the following command at the `CSM>` prompt to display the current status of the Loran and the GPS receivers.
	sources
	– Observe the following typical response for systems equipped with LFR:
	`N  Source Name Type       TO  Good Status   Last Phase Target Phase  Valid`
	`0  LocalGPS    Primary    4   YES  Good          0           0         Yes`
	`1  LFR CHA     Secondary  4   YES  Good     –2013177    –2013177      Yes`
	`2  Not Used`
	`Current reference source number: 0`
	– Observe the following typical response for systems equipped with HSO:
	`Num  Source Name  Type     TO  Good   Status  Last Phase  Target Phase Valid`
	` 0   Local GPS    Primary  4   Yes    Good        3            0       Yes`
	` 1   HSO          Backup   4   No     N/A    timed–out*  Timed–out*  No`
	
	NOTE
	“Timed–out” should only be displayed while the HSO is warming up. “Not–Present” or “Faulty” should not be displayed. If the HSO does not appear as one of the sources, then configure the HSO as a back–up source by entering the following command at the CSM> prompt:
	ss 1 12
	After a maximum of 15 minutes, the Rubidium oscillator should reach operational temperature and the LED on the HSO should now have changed from red to green. After the HSO front panel LED has changed to green, enter **sources <cr>** at the CSM> prompt. Verify that the HSO is now a valid source by confirming that the bold text below matches the response of the “sources” command.
	The HSO should be valid within one (1) minute, assuming the DPLL is locked and the HSO rubidium oscillator is fully warmed.
	`Num  Source Name  Type     TO  Good   Status  Last Phase  Target Phase Valid`
	` 0   Local GPS    Primary  4   Yes    Good        3            0       Yes`
	` 1   HSO          Backup   4   Yes    N/A    xxxxxxxxxx  xxxxxxxxxx  Yes`

3	HSO information (underlined text above, verified from left to right) is usually the #1 reference source. If this is not the case, have the *OMCR* determine the correct BTS timing source has been identified in the database by entering the **display bts csmgen** command and correct as required using the **edit csm csmgen refsrc** command.

. . . continued on next page

<table>
<tr><th colspan="2">Table 3-20: GPS Initialization/Verification</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4</td><td>If any of the above mentioned areas fail, verify:
– If LED is RED, verify that HSO had been powered up for at least 5 minutes. After oscillator temperature is stable, LED should go GREEN Wait for this to occur before continuing !
– If “timed out” is displayed in the Last Phase column, suspect the HSO output buffer or oscillator is defective
– Verify the HSO is FULLY SEATED and LOCKED to prevent any possible board warpage</td></tr>
<tr><td>5</td><td>Verify the following GPS information (underlined text above):
– GPS information is usually the 0 reference source.
– At least one Primary source must indicate “Status = good” and “Valid = yes” to bring site up.</td></tr>
<tr><td>6</td><td>Enter the following command at the <code>CSM></code> prompt to verify that the GPS receiver is in tracking mode.
gstatus
– Observe the following typical response:
<pre>
24:06:08 GPS Receiver Control Task State: tracking satellites.
24:06:08 Time since last valid fix: 0 seconds.
24:06:08
24:06:08 Recent Change Data:
24:06:08 Antenna cable delay 0 ns.
24:06:08 Initial position: lat 117650000 msec, lon –350258000 msec, height 0 cm (GPS)
24:06:08 Initial position accuracy (0): estimated.
24:06:08
24:06:08 GPS Receiver Status:
24:06:08 Position hold: lat 118245548 msec, lon –350249750 msec, height 20270 cm
24:06:08 Current position: lat 118245548 msec, lon –350249750 msec, height 20270 cm
(GPS)
24:06:08 8 satellites tracked, receiving 8 satellites, 8 satellites visible.
24:06:08 Current Dilution of Precision (PDOP or HDOP): 0.
24:06:08 Date & Time: 1998:01:13:21:36:11
24:06:08 GPS Receiver Status Byte: 0x08
24:06:08 Chan:0, SVID: 16, Mode: 8, RSSI: 148, Status: 0xa8
24:06:08 Chan:1, SVID: 29, Mode: 8, RSSI: 132, Status: 0xa8
24:06:08 Chan:2, SVID: 18, Mode: 8, RSSI: 121, Status: 0xa8
24:06:08 Chan:3, SVID: 14, Mode: 8, RSSI: 110, Status: 0xa8
24:06:08 Chan:4, SVID: 25, Mode: 8, RSSI: 83, Status: 0xa8
24:06:08 Chan:5, SVID: 3, Mode: 8, RSSI: 49, Status: 0xa8
24:06:08 Chan:6, SVID: 19, Mode: 8, RSSI: 115, Status: 0xa8
24:06:08 Chan:7, SVID: 22, Mode: 8, RSSI: 122, Status: 0xa8
24:06:08
24:06:08 GPS Receiver Identification:
24:06:08 COPYRIGHT 1991–1996 MOTOROLA INC.
24:06:08 SFTW P/N # 98–P36830P
24:06:08 SOFTWARE VER # 8
24:06:08 SOFTWARE REV # 8
24:06:08 SOFTWARE DATE 6 AUG 1996
24:06:08 MODEL #   B3121P1115
24:06:08 HDWR P/N # _
24:06:08 SERIAL #   SSG0217769
24:06:08 MANUFACTUR DATE 6B07
24:06:08 OPTIONS LIST   IB
24:06:08 The receiver has 8 channels and is equipped with TRAIM.
</pre></td></tr>
</table>

. . . continued on next page

Table 3-20: GPS Initialization/Verification

Step	Action
7	**Verify** the following GPS information (shown above in underlined text): – At least 4 satellites are tracked, and 4 satellites are visible. – GPS Receiver Control Task State is “tracking satellites”. ***Do not continue until this occurs!*** – Dilution of Precision indication is not more that 30. **Record** the current position base site latitude, longitude, height and height reference (height reference to Mean Sea Level (MSL) or GPS height (GPS). (GPS = 0 MSL = 1).
8	**If steps 1 through 7 pass, the GPS is good.** **NOTE** If any of the above mentioned areas fail, verify that: – If *Initial position accuracy* is “estimated” (typical), at least 4 satellites must be tracked and visible (1 satellite must be tracked and visible if actual lat, log, and height data for this site has been entered into CDF file). – If *Initial position accuracy* is “surveyed”, position data currently in the CDF file is assumed to be accurate. GPS will not automatically survey and update its position. – The GPS antenna is not obstructed or misaligned. – GPS antenna connector center conductor measures approximately +5 Vdc with respect to the shield. – There is no more than 4.5 dB of loss between the GPS antenna OSX connector and the BTS frame GPS input. – Any lightning protection installed between GPS antenna and BTS frame is installed correctly.

9	Enter the following commands at the `CSM>` prompt to verify that the CSM is warmed up and that GPS acquisition has taken place.
	debug dpllp
	Observe the following typical response if the CSM is not warmed up (15 minutes from application of power) ***(If warmed–up proceed to step 10)***
	`CSM>DPLL Task Wait. 884 seconds left.`
	`DPLL Task Wait. 882 seconds left.`
	`DPLL Task Wait. 880 seconds left.   ...........etc.`

	NOTE The **warm** command can be issued at the MMI port used to force the CSM into warm–up, but the reference oscillator will be unstable.

. . . continued on next page

3

Table 3-20: GPS Initialization/Verification

Step	Action

10	Observe the following typical response if the CSM is warmed up.
	`c:17486 off: –11, 3, 6 TK SRC:0 S0: 3 S1:–2013175,–2013175`
	`c:17486 off: –11, 3, 6 TK SRC:0 S0: 3 S1:–2013175,–2013175`
	`c:17470 off: –11, 1, 6 TK SRC:0 S0: 1 S1:–2013175,–2013175`
	`c:17486 off: –11, 3, 6 TK SRC:0 S0: 3 S1:–2013175,–2013175`
	`c:17470 off: –11, 1, 6 TK SRC:0 S0: 1 S1:–2013175,–2013175`
	`c:17470 off: –11, 1, 6 TK SRC:0 S0: 1 S1:–2013175,–2013175`

11	Verify the following GPS information (underlined text above, from left to right): – Lower limit offset from tracked source variable is not less than –60 (equates to 3μs limit). – Upper limit offset from tracked source variable is not more than +60 (equates to 3μs limit). – TK SRC: 0 is selected, where SRC 0 = GPS.
12	Enter the following commands at the `CSM>` prompt to exit the debug mode display. **debug dpllp**

3

LFR Initialization/Verification

The LORAN–C LFR is a full size card that resides in the C–CCP Shelf. The LFR is a completely self-contained unit that interfaces with the CSM via a serial communications link. The CSM handles the overall configuration and status monitoring functions of the LFR.

The LFR receives a 100 kHz, 35 kHz BW signal from up to 40 stations (8 chains) simultaneously and provides the following major functions:

- Automatic antenna pre-amplifier calibration (using a second differential pair between LFR and LFR antenna)
- A 1 second ±200 ηs strobe to the CSM

If the BTS is equipped with an LFR, follow the procedure in Table 3-21 to initialize the LFR and verify proper operation as a backup source for the GPS.

NOTE	If **CSMRefSrc2** = 2 in the CDF file, the BTS is equipped with an LFR. If **CSMRefSrc2** = 18, the BTS is equipped with an HSO.

<table>
<tr><th colspan="3">Table 3-21: LFR Initialization/Verification</th></tr>
<tr><th>Step</th><th>Action</th><th>Note</th></tr>
<tr><td>1</td><td>At the CSM> prompt, enter lstatus <cr> to verify that the LFR is in tracking mode. A typical response is:
<pre>
CSM> lstatus <cr>
LFR Station Status:
Clock coherence: 512 ------------------------->
5930M 51/60 dB 0   S/N Flag:
5930X 52/64 dn –1   S/N Flag:
5990   47/55 dB –6   S/N Flag:
7980M 62/66 dB 10   S/N Flag:
7980W 65/69 dB 14   S/N Flag: . PLL Station . ------->
7980X 48/54 dB –4   S/N Flag:
7980Y 46/58 dB –8   S/N Flag:E
7980Z 60/67 dB 8   S/N Flag:
8290M 50/65 dB 0   S/N Flag:
8290W 73/79 dB 20   S/N Flag:
8290W 58/61 dB 6   S/N Flag:
8970M 89/95 dB 29   S/N Flag:
8970W 62/66 dB 10   S/N Flag:
8970X 73/79 dB 22   S/N Flag:
8970Y 73/79 dB 19   S/N Flag:
8970Z 62/65 dB 10   S/N Flag:
9610M 62/65 dB 10   S/N Flag:
9610V 58/61 dB 8   S/N Flag:
9610W 47/49 dB –4   S/N Flag:E
9610X 46/57 dB –5   S/N Flag:E
9610Y 48/54 dB –5   S/N Flag:E
9610Z 65/69 dB 12   S/N Flag:
9940M 50/53 dB –1   S/N Flag:S
9940W 49/56 dB –4   S/N Flag:E
9940Y 46/50 dB–10   S/N Flag:E
9960M 73/79 dB 22   S/N Flag:
9960W 51/60 dB 0   S/N Flag:
9960X 51/63 dB –1   S/N Flag:
9960Y 59/67 dB 8   S/N Flag:
9960Z 89/96 dB 29   S/N Flag:

LFR Task State: lfr locked to station 7980W
LFR Recent Change Data:
  Search List: 5930 5990 7980 8290 8970 9940 9610 9960 ------>
  PLL GRI: 7980W
LFR Master, reset not needed, not the reference source.
CSM>
</pre></td><td>This must be greater than 100 before LFR becomes a valid source.

This shows the LFR is locked to the selected PLL station.

This search list and PLL data must match the configuration for the geographical location of the cell site.</td></tr>
<tr><td>2</td><td colspan="2">Verify the following LFR information (highlighted above in boldface type):
– Locate the “dot” that indicates the current phase locked station assignment (assigned by MM).
– Verify that the station call letters are as specified in site documentation as well as M X Y Z assignment.
– Verify the signal to noise (S/N) ratio of the phase locked station is greater than 8.</td></tr>
<tr><td>3</td><td colspan="2">At the CSM> prompt, enter sources <cr> to display the current status of the the LORAN receiver.
– Observe the following typical response.
<pre>
Num Source Name Type   TO Good   Status Last Phase Target Phase Valid
----
 0   Local GPS   Primary   4   Yes   Good   –3   0   Yes
 1   LFR ch A   Secondary 4   Yes   Good   –2013177   –2013177   Yes
 2   Not used
Current reference source number: 1
</pre></td></tr>
</table>

. . . continued on next page

Table 3-21: LFR Initialization/Verification

Step	Action	Note
4	LORAN–C LFR information (highlighted above in **boldface** type) is usually the #1 reference source (verified from left to right). **NOTE** If any of the above mentioned areas fail, verify: – The LFR antenna is not obstructed or misaligned. – The antenna pre–amplifier power and calibration twisted pair connections are intact and < 91.4 m (300 ft) in length. – A dependable connection to suitable Earth Ground is in place. – The search list and PLL station for cellsite location are correctly configured .	
	NOTE LFR functionality should be verified using the "source" command (as shown in Step 3). Use the underlined responses on the LFR row to validate correct LFR operation.	
5	Close the Hyperterminal window.	

HSO Initialization/Verification

The HSO module is a full–size card that resides in the C–CCP Shelf. This completely self contained high stability 10 MHz oscillator interfaces with the CSM via a serial communications link. The CSM handles the overall configuration and status monitoring functions of the HSO. In the event of GPS failure, the HSO is capable of maintaining synchronization initially established by the GPS reference signal for a limited time.

The HSO is typically installed in those geographical areas not covered by the LORAN–C system and provides the following major functions:

- Reference oscillator temperature and phase lock monitor circuitry
- Generates a highly stable 10 MHz sine wave.
- Reference divider circuitry converts 10 MHz sine wave to 10 MHz TTL signal, which is divided to provide a 1 PPS strobe to the CSM.

Prerequisites

- The LMF is not logged into the BTS.
- The COM1 port is connected to the MMI port of the primary CSM via a null modem board.
- The primary CSM and the HSO (if equipped) have warmed up for 15 minutes.

If the BTS is equipped with an HSO, follow the procedure in Table 3-22 to configure the HSO.

Table 3-22: HSO Initialization/Verification

Step	Action
1	At the BTS, slide the HSO card into the cage. **NOTE** The LED on the HSO should light *red* for no longer than 15-minutes, then switch to *green*. The CSM must be locked to GPS.

2	On the LMF at the **CSM>** prompt, enter **sources <cr>**.
	– Observe the following typical response for systems equipped with HSO:
	`Num Source Name Type TO Good Status Last Phase Target Phase Valid`
	`0 Local GPS Primary 4 Yes Good 0 0 Yes`
	`1 HSO` `Backup 4` **`Yes`** `N/A xxxxxxx –69532` **`Yes`**
	`2 Not used`
	`Current reference source number: 0`
	When the CSM is locked to GPS, verify that the HSO “Good” field is *Yes* and the “Valid” field is *Yes*.

3	If source “1” is **not** configured as HSO, enter at the **CSM>** prompt: **ss 1 12 <cr>** Check for *Good* in the Status field.
4	At the **CSM>** prompt, enter **sources <cr>**. Verify the HSO valid field is *Yes*. If not, repeat this step until the “Valid” status of *Yes* is returned. The HSO should be valid within one (1) minute, assuming the DPLL is locked and the HSO Rubidium oscillator is fully warmed.

Test Equipment Set-up

Connecting Test Equipment to the BTS

The following equipment is required to perform optimization:

- LMF
- Test set
- Directional coupler and attenuator
- RF cables and connectors
- Null modem cable (see Figure 3-10)
- GPIB interface box

Refer to Table 3-23 and Table 3-24 for an overview of connections for test equipment currently supported by the LMF. In addition, see the following figures:

- Figure 3-16 and Figure 3-17 show the test set connections for TX calibration.
- Figure 3-19 and Figure 3-20 show test set connections for IS–95 A/B optimization/ATP tests.
- Figure 3-21 shows test set connections for IS–95 A/B and CDMA 2000 optimization/ATP tests.
- Figure 3-23 and Figure 3-24 show typical TX and RX ATP setup with a directional coupler (shown with and without RFDS).

Test Equipment GPIB Address Settings

All test equipment is controlled by the LMF through an IEEE–488/GPIB bus. To communicate on the bus, each piece of test equipment must have a GPIB address set which the LMF will recognize. The standard address settings used by the LMF for the various types of test equipment items are as follows:

- Signal generator address: **1**
- Power meter address: **13**
- Communications system analyzer: **18**

Using the procedures included in the Verifying and Setting GPIB Addresses section of Appendix F, verify and, if necessary, change the GPIB address of each piece of employed test equipment to match the applicable addresses above

Supported Test Equipment

CAUTION	To prevent damage to the test equipment, all TX test connections must be through the directional coupler and in-line attenuator as shown in the test setup illustrations.

IS–95 A/B Testing

Optimization and ATP testing for IS–95A/B may be performed using one of the following test sets:

- CyberTest
- Advantest R3465 and HP 437B or Gigatronics Power Meter
- Hewlett–Packard HP 8935
- Hewlett–Packard HP 8921 (W/CDMA and PCS Interface for 1.7/1.9 GHz) and HP 437B or Gigatronics Power Meter

The equipment listed above cannot be used for CDMA 2000 testing.

CDMA2000 1X Operation

Optimization and ATP testing for CDMA2000 1X sites or carriers may be performed using the following test equipment:

- Advantest R3267 Analyzer with Advantest R3562 Signal Generator
- Agilent E4406A with E4432B Signal Generator
- Agilent 8935 series E6380A communications test set (formerly HP 8935) with option 200 or R2K and with E4432B signal generator for 1X FER

The E4406A/E4432B pair, or the R3267/R3562 pair, should be connected together using a GPIB cable. In addition, the R3562 and R3267 should be connected with a serial cable from the Serial I/O to the Serial I/O. This test equipment is capable of performing tests in both IS–95 A/B mode and CDMA 2000 mode if the required options are installed.

- Agilent E7495A communications test set

Optional test equipment

- Spectrum Analyzer (HP8594E) – can be used to perform cable calibration.

Test Equipment Preparation

See Appendix F for specific steps to prepare each type of test set and power meter to perform calibration and ATP.

Agilent E7495A communications test set requires additional setup and preparation. This is described in detail in Appendix F.

3

Test Equipment Connection Charts

To use the following charts to identify necessary test equipment connections, locate the communications system analyzer being used in the **COMMUNICATIONS SYSTEM ANALYZER** columns, and read down the column. Where a dot appears in the column, connect one end of the test cable to that connector. Follow the horizontal line to locate the end connection(s), reading up the column to identify the appropriate equipment and/or BTS connector.

IS–95A/B–only Test Equipment Connections

Table 3-23 depicts the interconnection requirements for currently available test equipment *supporting IS–95A/B only* which meets Motorola standards and is supported by the LMF.

Table 3-23: IS–95 **A/B** Test Equipment Setup

	COMMUNICATIONS SYSTEM ANALYZER					ADDITIONAL TEST EQUIPMENT				
SIGNAL	Cyber–Test	Advant-est R3465	HP 8935	HP 8921A	HP 8921 W/PCS	Power Meter	GPIB Inter-face	LMF	30 dB Direction-al Coupler & 20 dB Pad*	BTS
EVEN SECOND SYNCHRONIZATION	EVEN SEC REF	EVEN SEC SYNC IN	EVEN SECOND SYNC IN	EVEN SECOND SYNC IN	EVEN SECOND SYNC IN					SYNC MONITOR
	●									●
		●								●
			●							●
				●						●
					●					●
19.6608 MHZ CLOCK	TIME BASE IN	CDMA TIME BASE IN	EXT REF IN	CDMA TIME BASE IN	CDMA TIME BASE IN					FREQ MONITOR
	●									●
		●								●
			●							●
				●						●
					●					●
CONTROL IEEE 488 BUS	IEEE 488	GPIB	HP–IB	HP–IB	HP–IB	HP–IB	GPIB	SERIAL PORT		
	●						●	●		
		●				●	●	●		
			●				●	●		
				●		●	●	●		
					●	●	●	●		
TX TEST CABLES	RF IN/OUT	INPUT 50–OHM	RF IN/OUT	RF IN/OUT	RF IN/OUT				30 DB COUPLER AND 20 DB PAD	TX1–6
	●								●	●
		●							●	●
			●						●	●
				●					●	●
					●				●	●
RX TEST CABLES	RF GEN OUT	RF OUT 50–OHM	RF IN/OUT	DUPLEX OUT	RF OUT ONLY					RX1–6
	●									●
		●								●
			●							●
				●						●
					●					●

3

CDMA2000 1X/IS–95A/B–capable Test Equipment Connections

Table 3-24 depicts the interconnection requirements for currently available test equipment supporting *both* CDMA 2000 1X *and* IS–95A/B which meets Motorola standards and is supported by the LMF.

Table 3-24: CDMA2000 1X/IS–95A/B Test Equipment Interconnection

	COMMUNICATIONS SYSTEM ANALYZER				ADDITIONAL TEST EQUIPMENT						
SIGNAL	Agilent 8935 (Option 200 or R2K)	Agilent E7495A	Advan test R3267	Agilent E4406A	Agilent E4432B Signal Generator	Advantest R3562 Signal Generator	Power Meter	GPIB Interface	LMF	30 dB Directional Coupler & 20 dB Pad*	BTS
EVEN SECOND SYNCHRONIZATION	EXT TRIG IN	EVEN SECOND SYNC IN	EXT TRIG	TRIGGER IN	PATTERN TRIG IN	EVEN SECOND SYNC IN					SYNC MONI TOR
(connection)	●				●						●
(connection)		●									●
(connection)			●								●
(connection)				●	●						●
19.6608 MHZ CLOCK	MOD TIME BASE IN			EXT REF IN		EXT REF IN					FREQ MONITOR
(connection)	●										●
(connection)				●							●
(connection)						●					●
CONTROL IEEE 488 BUS	IEEE 488		GPIB	HP–IB	GPIB	HP–IB	HP–IB	GPIB	SERIAL PORT		
(connection)	●							●	●		
(connection)			●				●	●	●		
(connection)				●			●	●	●		
10 MHZ	10 MHZ IN		10 MHZ OUT	10 MHZ OUT (SWITCHED)	10 MHZ IN	SYNTHE REF IN					
(connection)	●				●						
(connection)			●			●					
(connection)				●	●						
SIGNAL SOURCE CONTROLLED SERIAL I/O			SERIAL I/O			SERIAL I/O					
(connection)			●			●					
TX TEST CABLES	RF IN/OUT	PORT 2 RF IN	RF IN	RF INPUT 50 OHM	RF OUTPUT 50 OHM	RF IN/OUT				30 DB COUPLER AND 20 DB PAD	TX1–6
(connection)	●									●	●
(connection)		●								●	●
(connection)			●							●	●
(connection)				●						●	●
RX TEST CABLES	DUPLEX OUT *	PORT 1 RF OUT	RF OUT 50–OHM	RF OUT ONLY	RF OUTPUT 50–OHM	RF OUT 50 OHM					RX1–6
(connection)	●										●
(connection)		●								●	●
(connection)					●						●
(connection)						●					●

* WHEN USED ALONE, THE AGILENT 8935 WITH OPTION 200 OR R2K SUPPORTS IS–95A/B RX TESTING BUT NOT CDMA2000 1X RX TESTING.

Equipment Warm-up

NOTE	To assure BTS stability and contribute to optimization accuracy of the BTS, warm-up the BTS test equipment prior to performing the BTS optimization procedure as follows: – Agilent E7495A for a minimum of 30 minutes – All other test sets for a minimum of 60 minutes Time spent running initial or normal power-up, hardware/ firmware audit, and BTS download counts as warm-up time.

3

WARNING	Before installing any test equipment directly to any BTS **TX OUT** connector, verify there are *no* CDMA channels keyed. – At active sites, have the OMC-R/CBSC place the antenna (sector) assigned to the LPA under test OOS. Failure to do so can result in serious personal injury and/or equipment damage.

Automatic Cable Calibration Set–up

Figure 3-12 through Figure 3-15 show the cable calibration setup for various supported test sets. The left side of the diagram depicts the location of the input and output ports of each test set, and the right side details the set up for each test.

Manual Cable Calibration

If manual cable calibration is required, refer to the procedures in Appendix F.

Figure 3-12: IS–95A/B Cable Calibration Test Setup – CyberTest, Agilent 8935, Advantest R3465, and HP 8921A

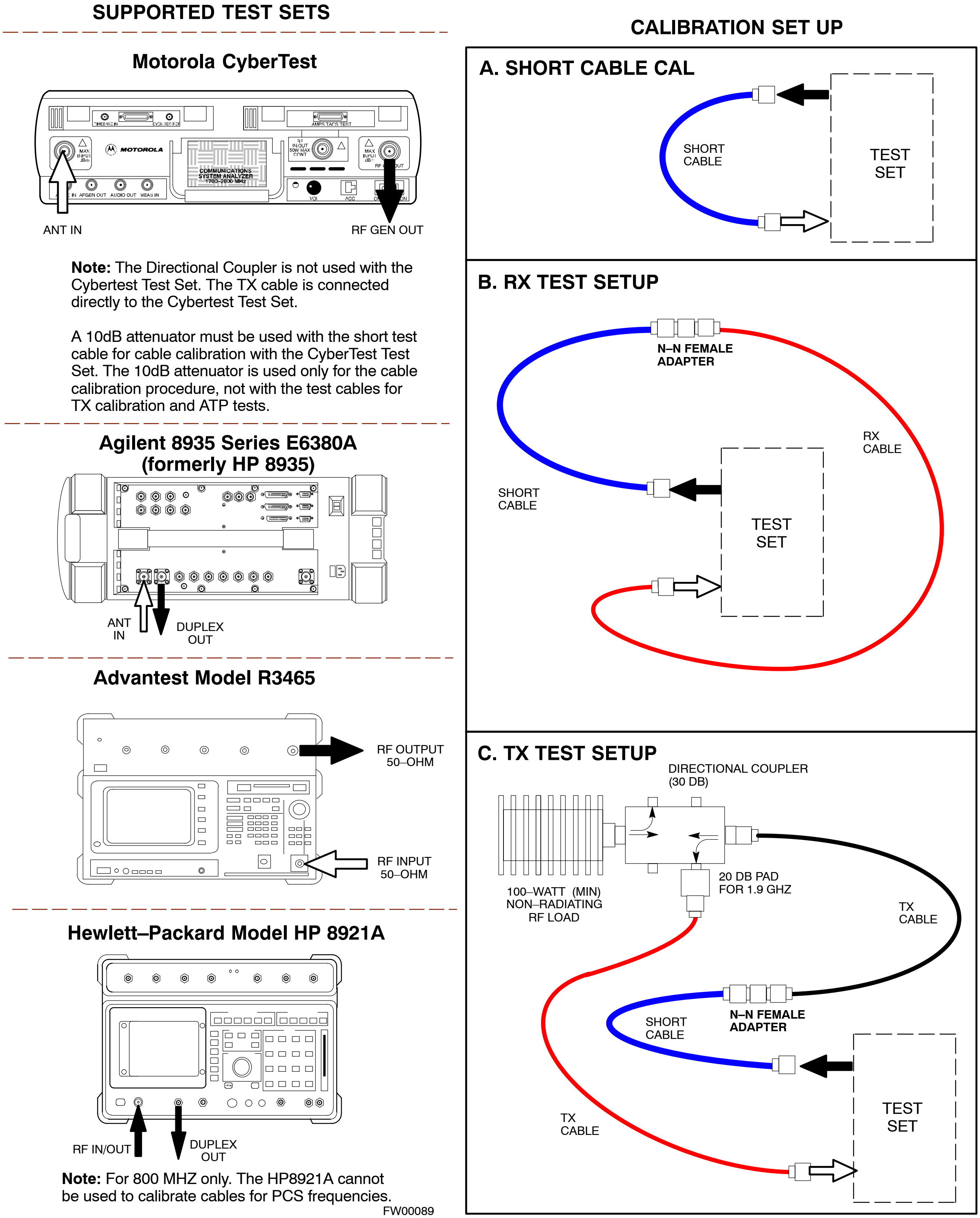


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Figure 3-13: IS–95A/B and CDMA 2000 1X Cable Calibration Test Setup – Agilent E4406A/E4432B and Advantest R3267/R3562

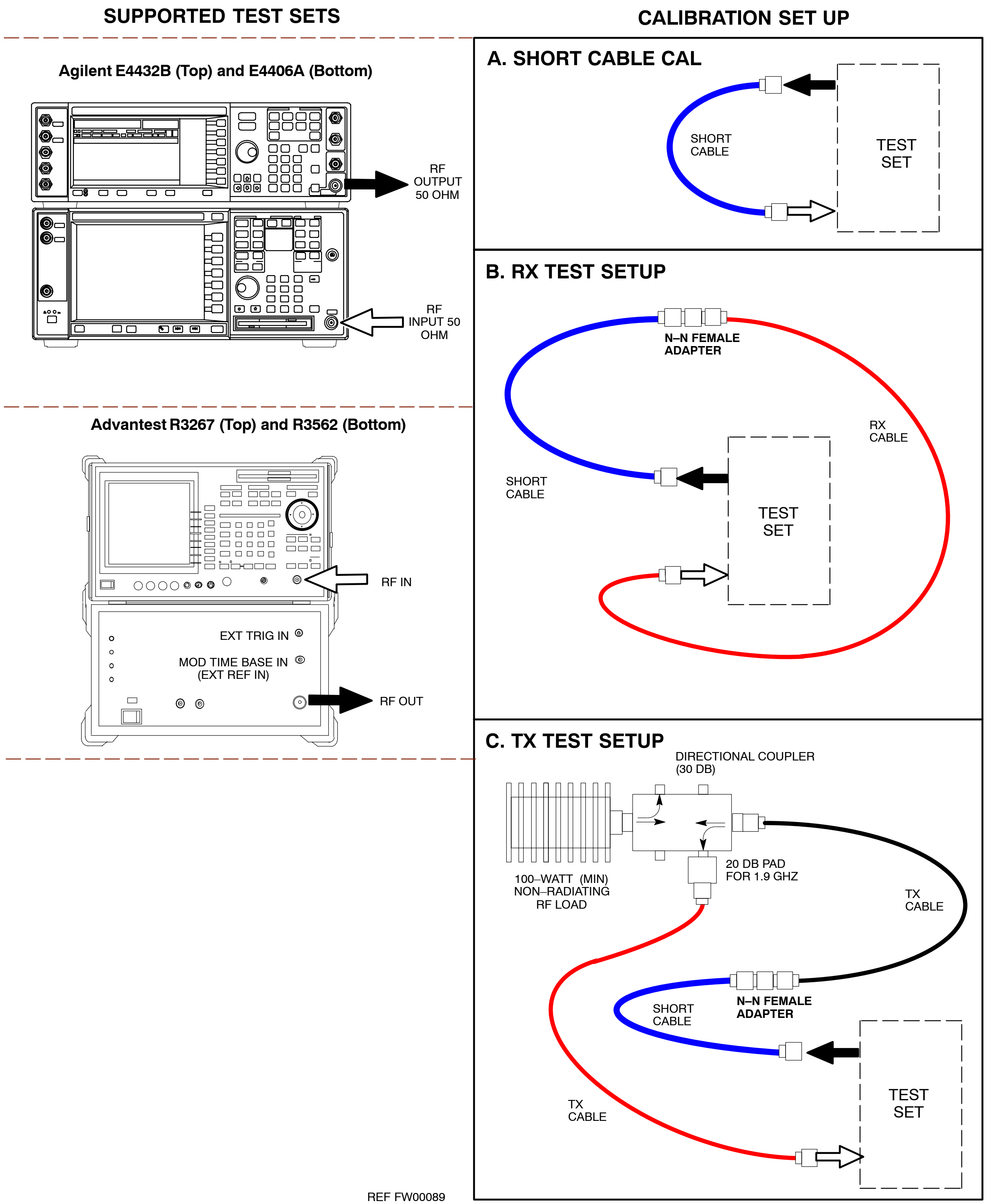


Figure 3-14: CDMA2000 1X Cable Calibration Test Setup – Agilent 8935/E4432B

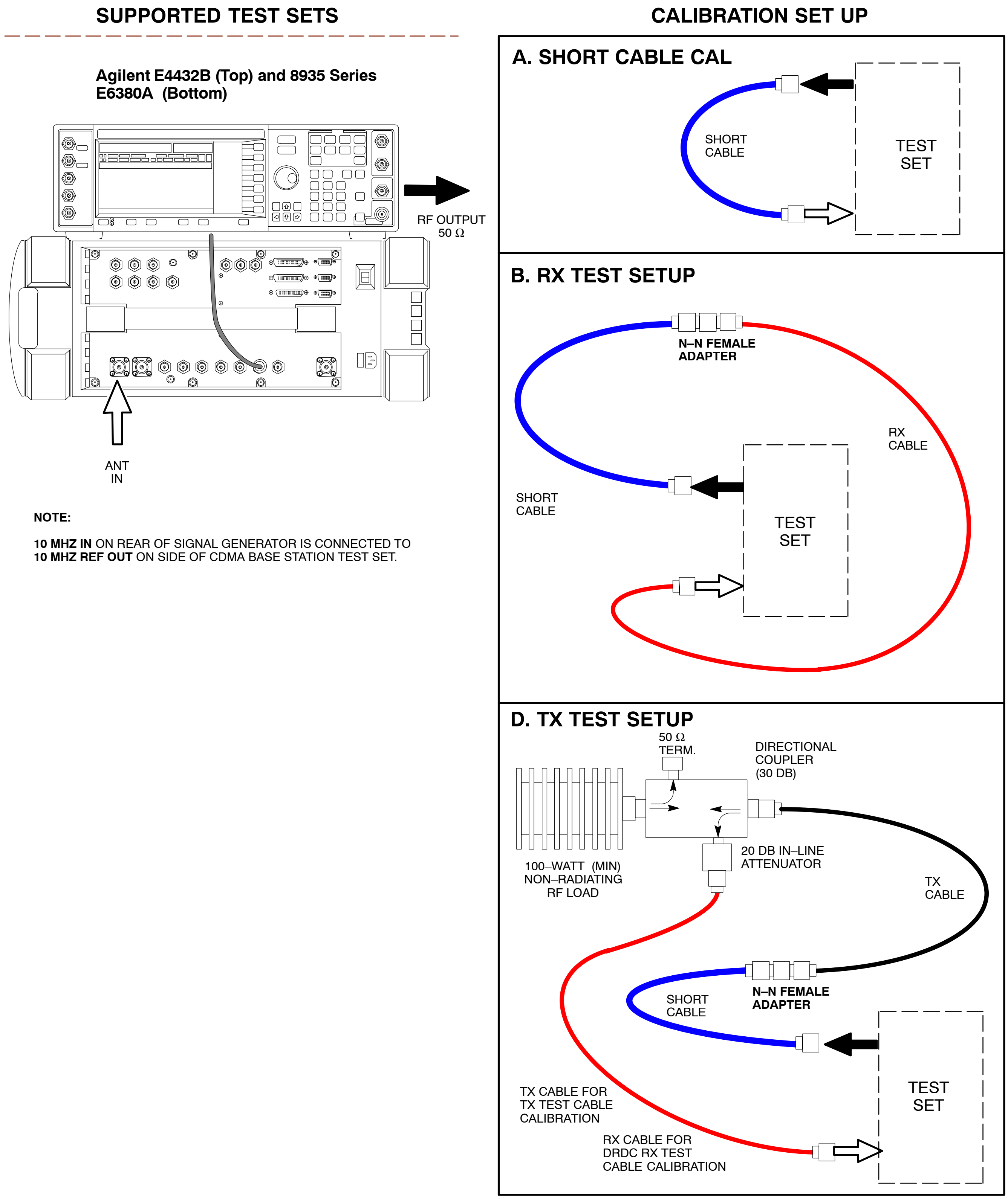
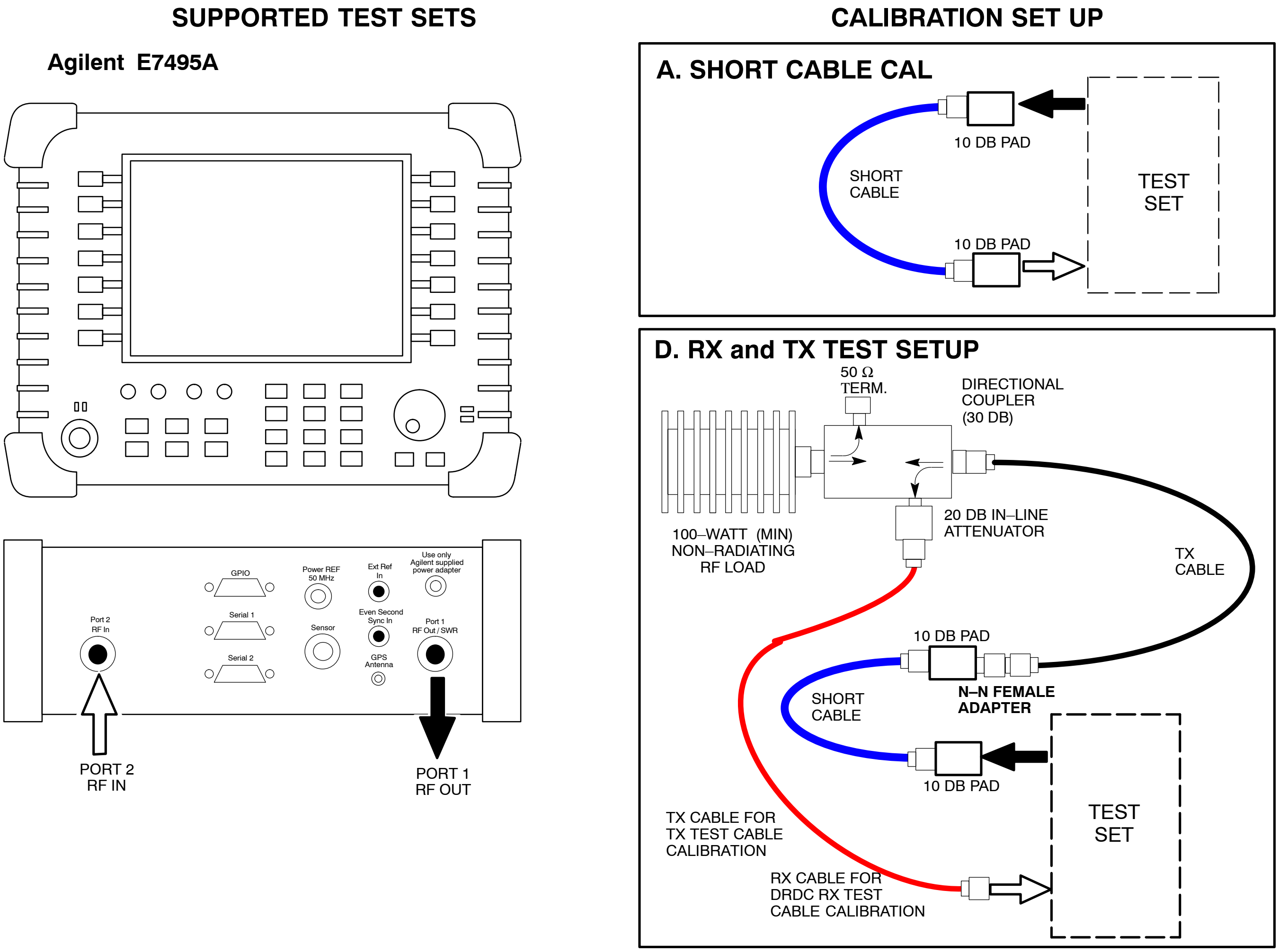


Figure 3-15: CDMA2000 1X Cable Calibration Test Setup – Agilent E7495A



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Set-up for TX Calibration

Figure 3-16 through Figure 3-18 show the test set connections for TX calibration.

Figure 3-16: TX Calibration Test Setup – CyberTest (IS–95A/B) and Agilent 8935 (IS–95A/B and CDMA2000 1X), and Advantest R3465

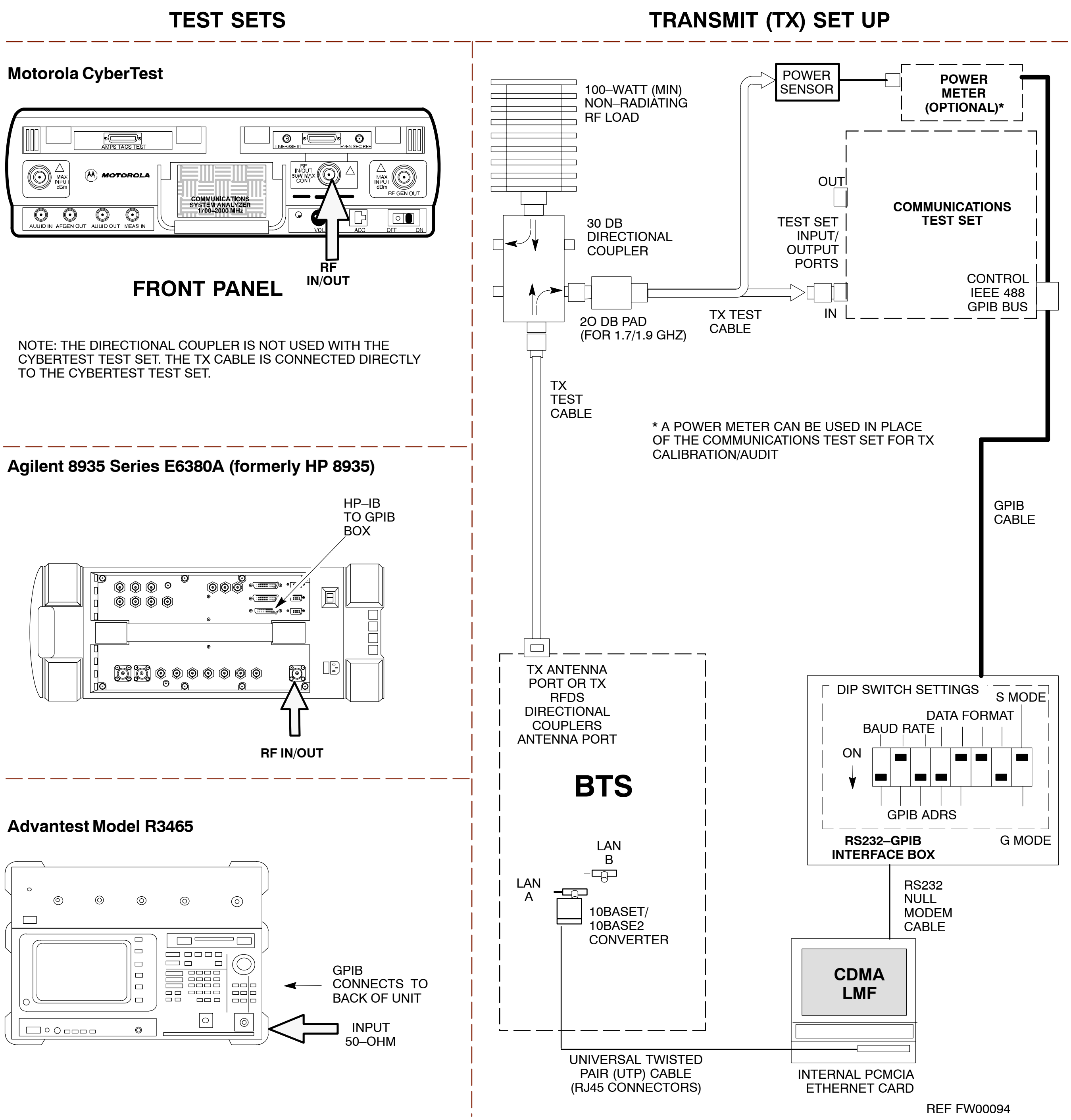

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Figure 3-17: TX Calibration Test Setup – Agilent E4406A and Advantest R3567 (IS–95A/B and CDMA2000 1X)

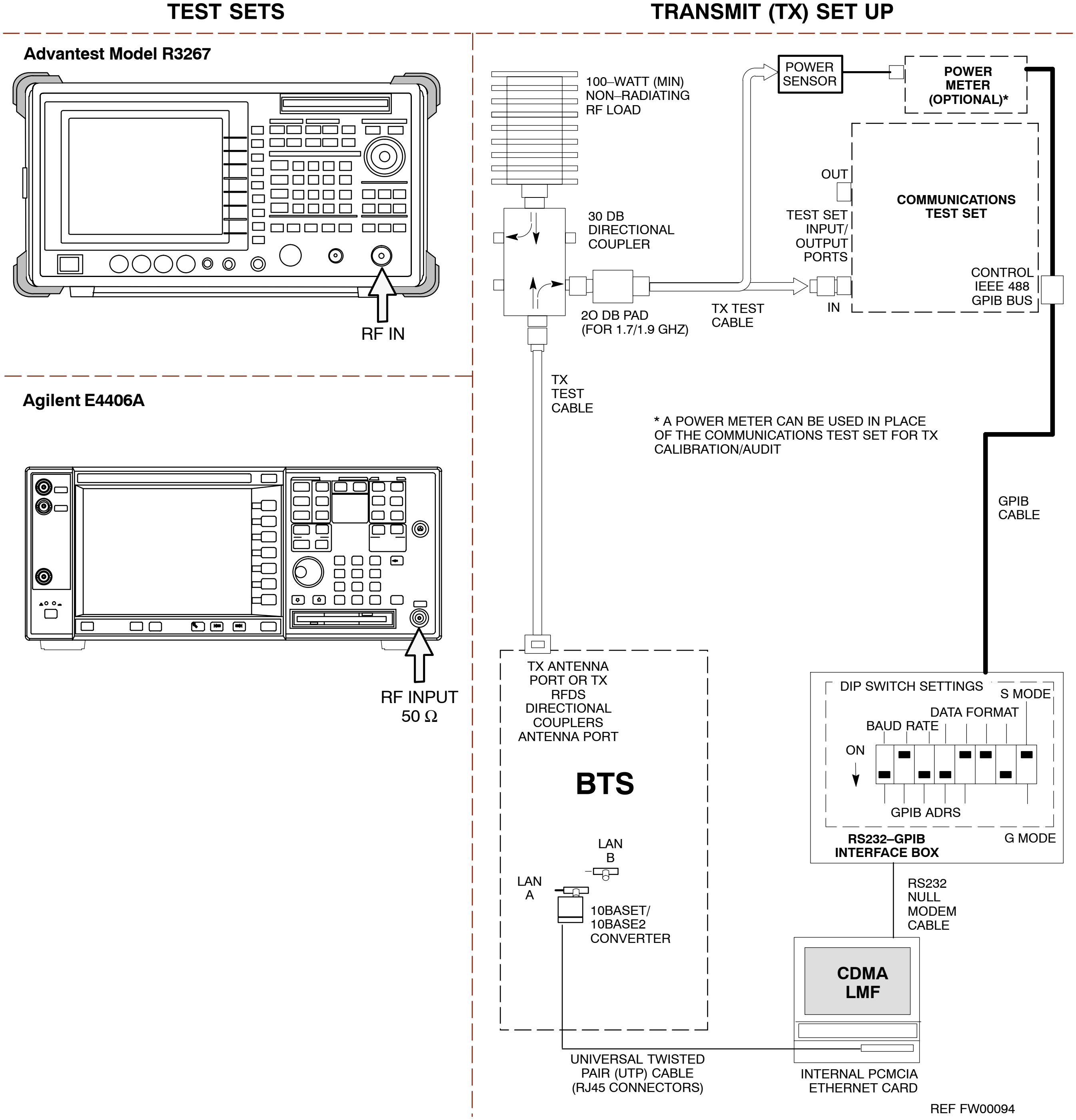
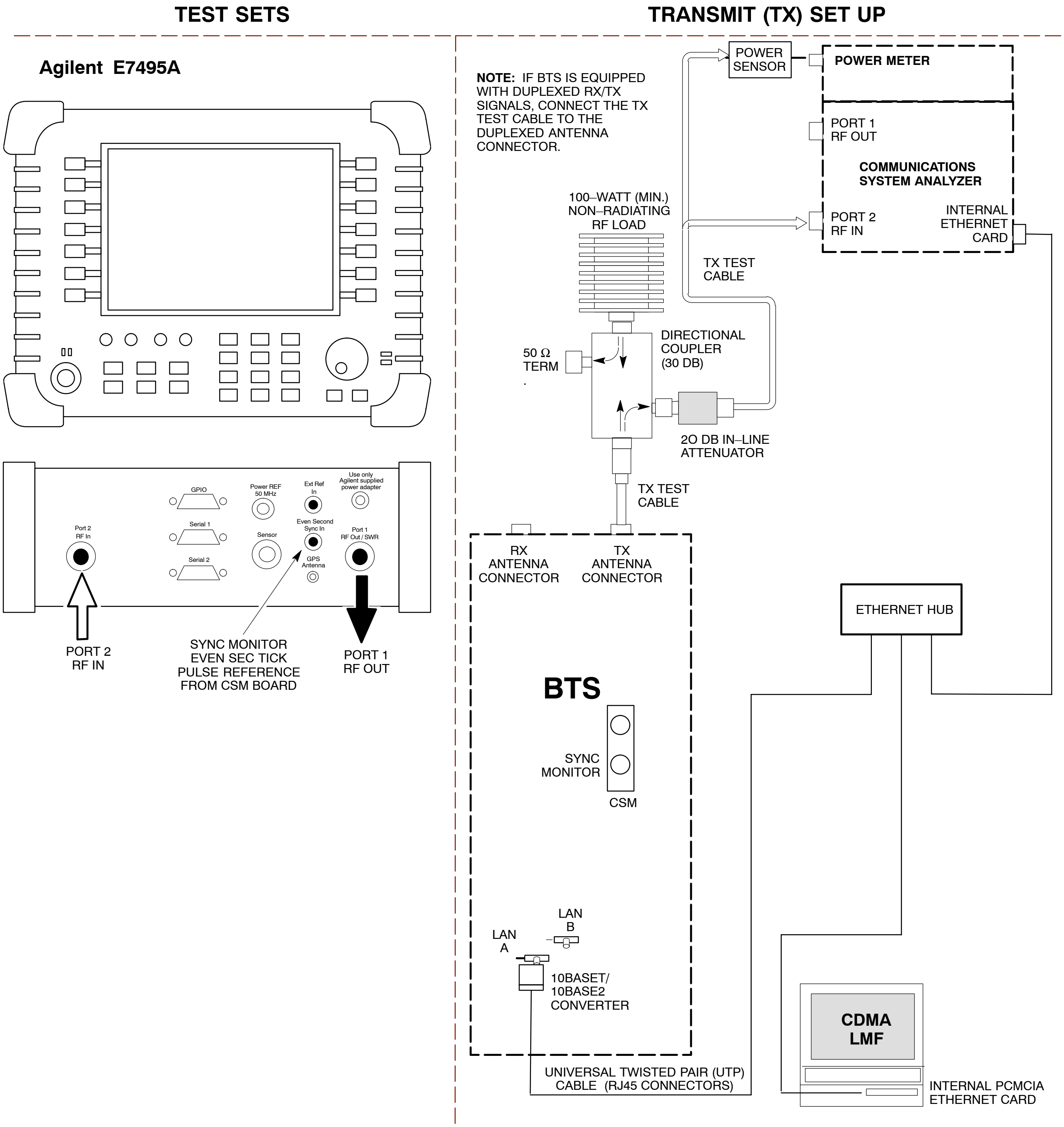


Figure 3-18: TX Calibration Test Setup – Agilent E7495A (IS–95A/B and CDMA2000 1X)



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Setup for Optimization/ATP

Figure 3-19 and Figure 3-21 show test set connections for IS–95 A/B optimization/ATP tests. Figure 3-21 and Figure 3-22 show test set connections for IS-95 A/B/C optimization/ATP tests.

Figure 3-19: Optimization/ATP Test Setup Calibration – Agilent 8935

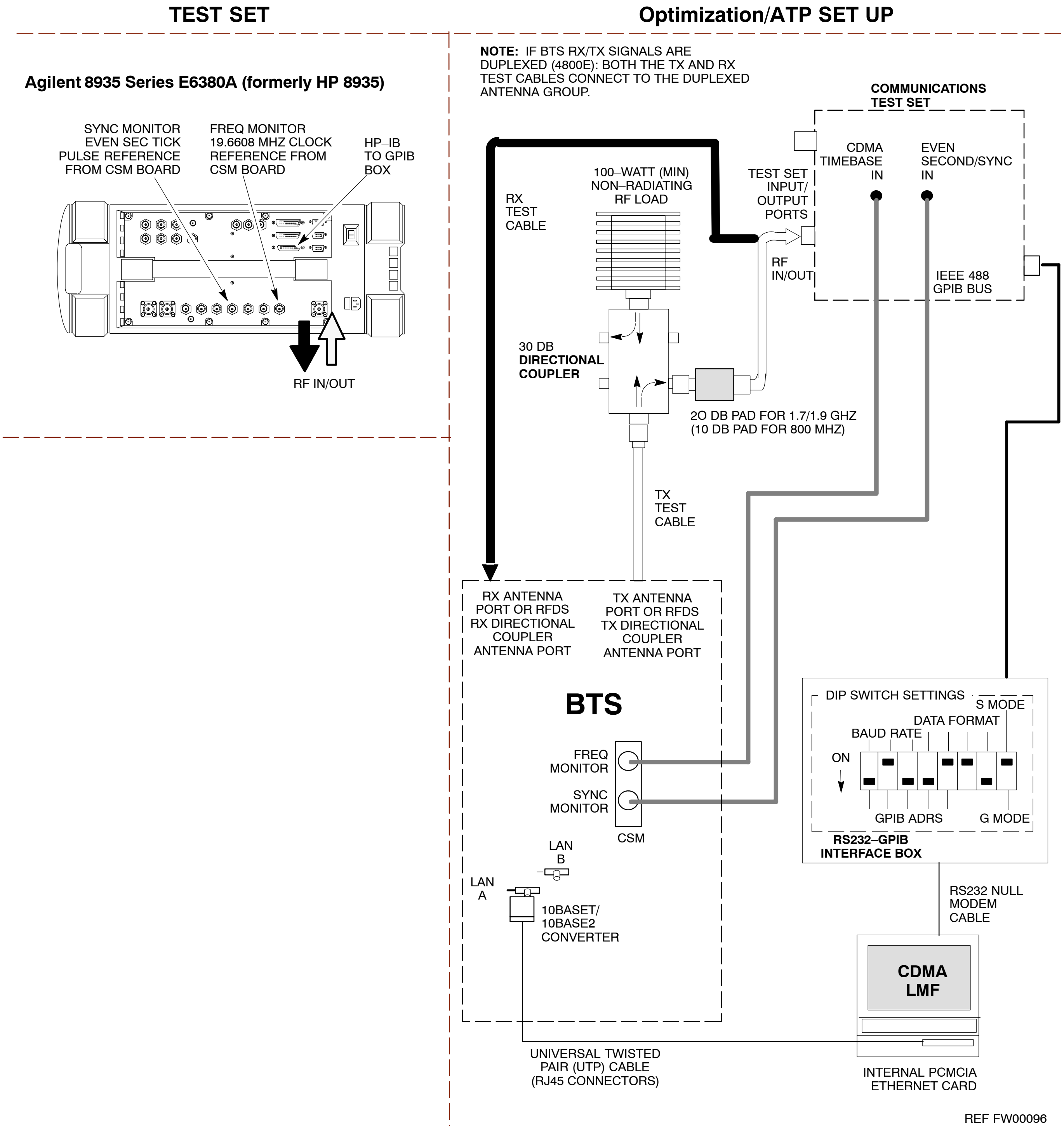

Figure 3-20: Optimization/ATP Test Setup – HP 8921

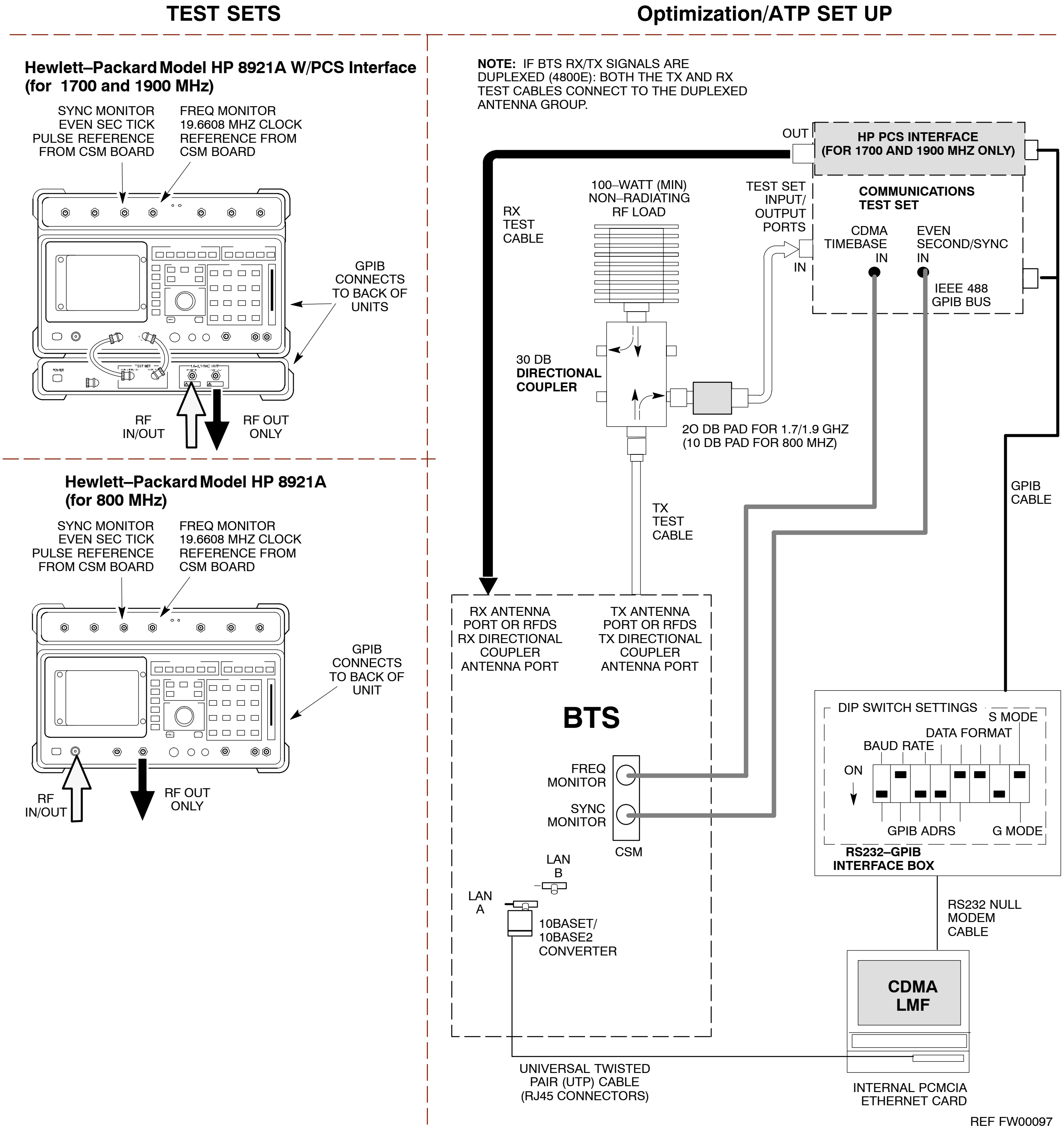

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Figure 3-21: *IS–95A/B and CDMA2000 1X* Optimization/ATP Test Setup – Advantest R3267/3562, Agilent E4432B/E4406A

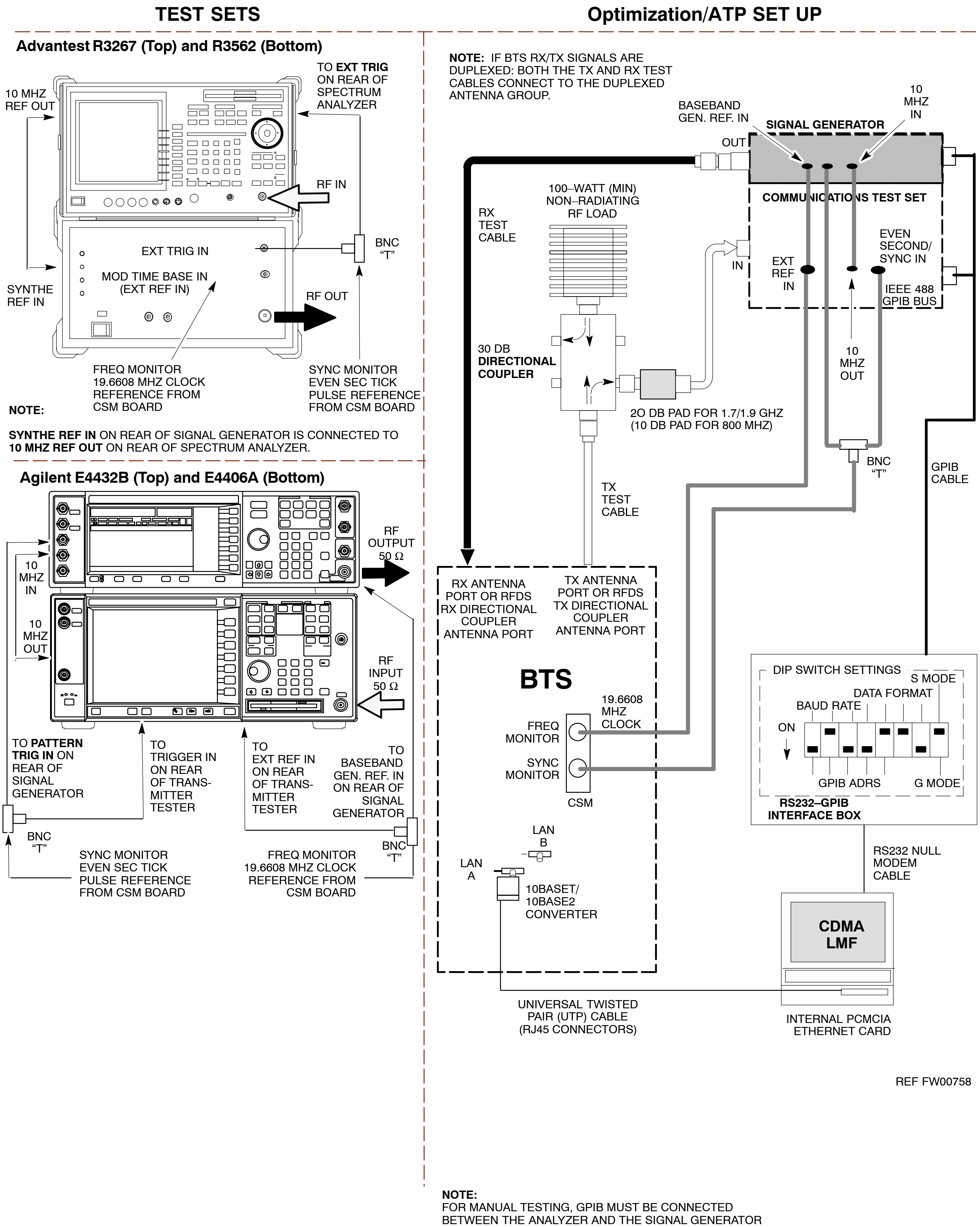
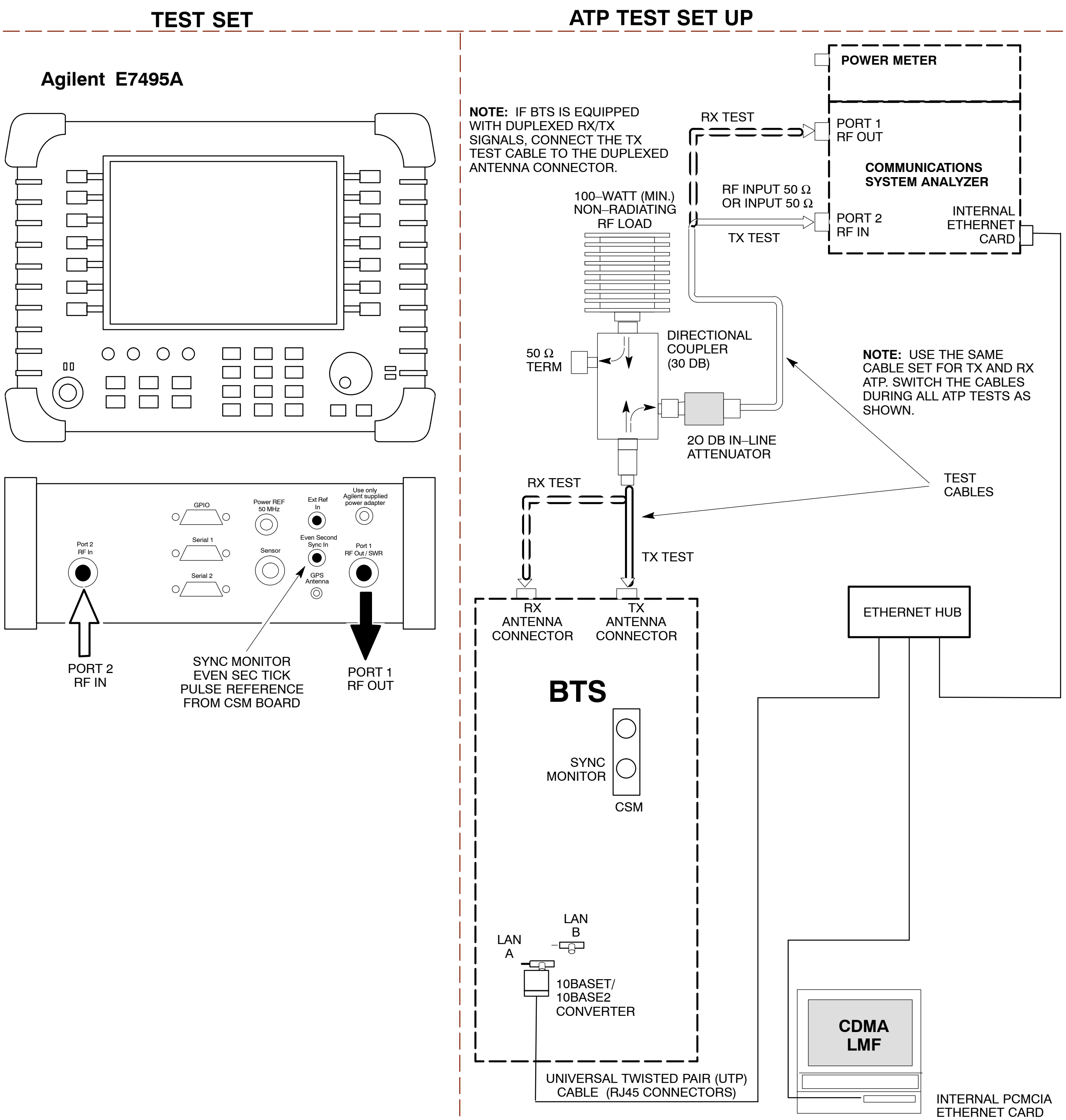


Figure 3-22: *IS–95A/B and CDMA2000 1X* Optimization/ATP Test Setup – Agilent E7495A



ATP Setup with Directional Couplers

Figure 3-23 shows a typical TX ATP setup.

Figure 3-23: Typical TX ATP Setup with Directional Coupler

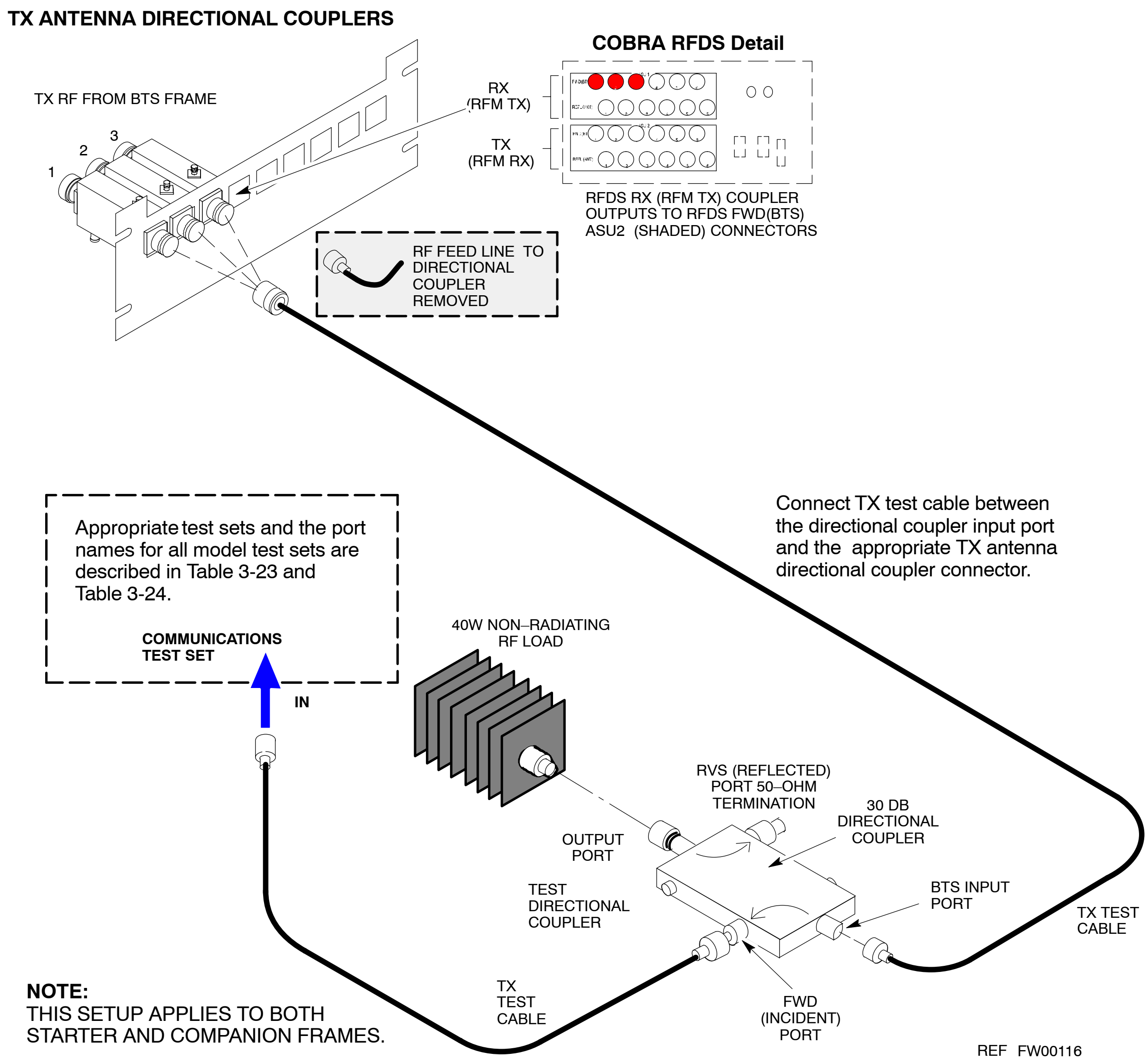
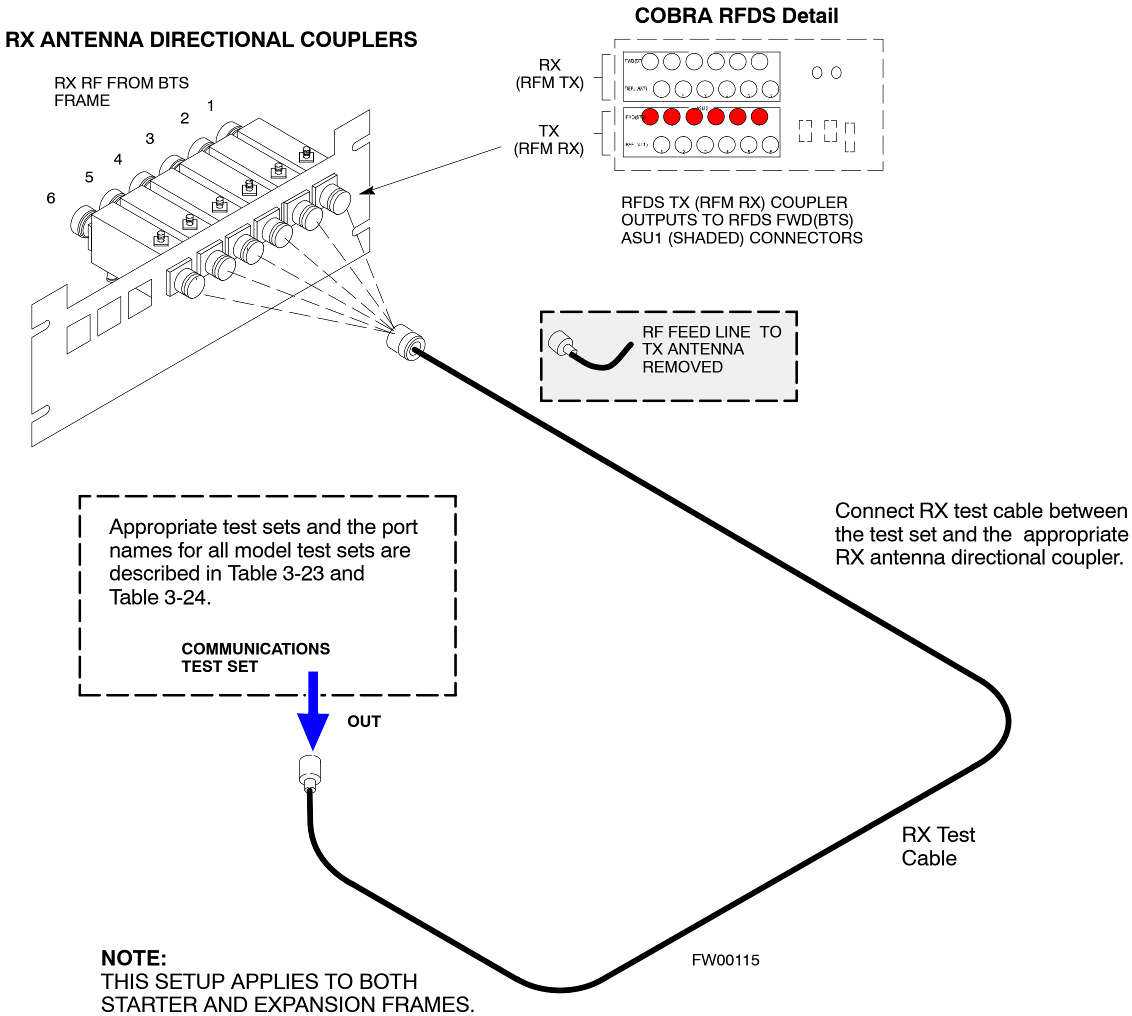


Figure 3-24: Typical RX ATP Setup with Directional Coupler

Figure 3-24 shows a typical RX ATP setup.



Test Set Calibration

Background

Proper test equipment calibration ensures that the test equipment and associated test cables do not introduce measurement errors, and that measurements are correct.

NOTE	If the *test equipment set* being used to optimize or test the BTS has been calibrated and maintained as a set, this procedure does not need to be performed.

This procedure must be performed *prior* to beginning the optimization. Verify all test equipment (including all associated test cables and adapters actually used to interface all test equipment and the BTS) has been calibrated and maintained as a set.

CAUTION	If any piece of test equipment, test cable, or RF adapter that makes up the calibrated *test equipment set* has been replaced, the *set* must be re-calibrated. Failure to do so can introduce measurement errors, resulting in incorrect measurements and degradation to system performance. Motorola recommends repeating cable calibration before testing at each BTS site.

NOTE	Calibration of the communications system analyzer (or equivalent test equipment) must be performed at the site before calibrating the overall *test equipment set*. Calibrate the test equipment *after* it has been allowed to warm–up and stabilize for a *minimum of 60 minutes*.

Calibration Procedures Included

Automatic

Procedures included in this section use the LMF automated calibration routine to determine path losses of the supported communications analyzer, power meter, associated test cables, adapters, and (if used) antenna switch that make up the overall calibrated *test equipment set*. After calibration, the gain/loss offset values are stored in a test measurement offset file on the LMF computer.

Manual

Agilent E4406A Transmitter Tester – The E4406A does not support the power level zeroing calibration performed by the LMF. If this instrument is to be used for Bay Level Offset calibration and calibration is attempted with the LMF **Calibrate Test Equipment** function, the LMF will return a status window failure message stating that zeroing power is not supported by the E4406A. Refer to the Equipment Calibration section of Appendix F for instructions on using the instrument's self–alignment (calibration) function prior to performing Bay Level Offset calibration.

Power Meters – Manual power meter calibration procedures to be performed prior to automated calibration are included in the Equipment Calibration section of Appendix F**.**

Cable Calibration – Manual cable calibration procedures using the HP 8921A and Advantest R3465 communications system analyzers are provided in the Manual Cable Calibration section of Appendix F, if needed.

GPIB Addresses

GPIB addresses can range from 1 through 30. The LMF will accept any address in that range, but the numbers entered in the LMF Options window GPIB address box must match the addresses of the test equipment. Motorola recommends using 1 for a CDMA signal generator, 13 for a power meter, and 18 for a communications system analyzer. To verify and, if necessary, change the GPIB addresses of the test equipment, refer to the Setting GPIB Addresses section of Appendix F.

IP Addresses

For the Agilent E7495A Communications Test Set, set the IP address and complete initial setup as described in Appendix F (Specifically, see Table F-1 on page F-3).

Selecting Test Equipment

Serial Connection and **Network Connection** tabs are provided in the **LMF Options** window to specify the test equipment connection method. The **Serial Connection** tab is used when the test equipment items are connected directly to the LMF computer through a GPIB box (normal setup). The **Network Connection** tab is used when the test equipment is to be connected remotely via a network connection or the Agilent E7495A Communications Test Set is used. Refer to Appendix F (Specifically, see Table F-1 on page F-3).

Prerequisites

Ensure the following prerequisites have been met before proceeding:

- Test equipment is correctly connected and turned on.
- GPIB addresses set in the test equipment have been verified as correct using the applicable procedures in Appendix F. (GPIB not applicable with Agilent E7495A)
- LMF computer serial port and test equipment are connected to the GPIB box. (GPIB not applicable with Agilent E7495A)

Selecting Test Equipment

Test equipment may be selected either manually with operator input or automatically using the LMF autodetect feature.

Manually Selecting Test Equipment in a Serial Connection Tab

Test equipment can be manually specified before, or after, the test equipment is connected. The LMF does not check to see if the test equipment is actually detected for manual specification. Follow the procedure in Table 3-25 to select test equipment manually.

Table 3-25: Selecting Test Equipment Manually in a Serial Connection Tab

✓	Step	Action
	1	In the LMF window menu bar, click **Tools** and select **Options...** from the pull–down menu. The **LMF Options** window appears.
	2	Click on the **Serial Connection** tab (if not in the forefront).
	3	Select the correct serial port in the **COMM Port** pick list (normally **COM1**).
	4	Click on the **Manual Specification** button (if not enabled).
	5	Click on the check box corresponding to the test item(s) to be used.
	6	Type the GPIB address in the corresponding GPIB address box (refer to the Setting GPIB Addresses section of Appendix F for directions on verifying and/or changing test equipment GPIB addresses). Motorola–recommended addresses are: **1** = signal generator **13** = power meter **18** = communications system analyzer *** IMPORTANT** When test equipment items are manually selected by the operator, the LMF defaults to using a power meter for RF power measurements. The LMF will use a communications system analyzer for RF power measurements only if a power meter is not selected (power meter checkbox not checked).
	7	Click on **Apply**. (The button darkens until the selection has been committed.) **NOTE** With manual selection, the LMF does not attempt to detect the test equipment to verify it is connected and communicating with the LMF. To verify and, if necessary, change the GPIB address of the test equipment, refer to Appendix F.
	8	Click on **Dismiss** to close the **LMF Options** window.

Automatically Selecting Test Equipment in Serial Connection Tab

When using the auto-detection feature to select test equipment, the LMF examines which test equipment items are actually communicating with the LMF. Follow the procedure in Table 3-26 to use the auto-detection feature.

Table 3-26: Selecting Test Equipment Using Auto-Detect

✓	Step	Action
	1	In the LMF window menu bar, click **Tools** and select **Options...** from the pull–down menu. The **LMF Options** window appears.
	2	If it is not in the forefront, click on the **Serial Connection** tab.
	3	Select the correct serial port in the **COMM Port** pick list (normally **COM1**).
	4	*If it is not selected (no black dot showing)*, click on the **Auto–Detection** button.
	5	*If they are not already displayed* in the box labeled **GPIB address to search**, click in the box and type in the GPIB addresses for the test equipment to be used, separating each address *with commas and no spaces*. (Refer to the Setting GPIB Addresses section of Appendix F for instructions on verifying and/or changing test equipment GPIB addresses.) **NOTE** During the GPIB address search for a test equipment item to perform RF power measurements (that is, for TX calibration), the LMF will select the first item it finds with the capability to perform the measurement. If, for example, the address sequence **13,18,1** is included in the **GPIB addresses to search** box, the power meter (GPIB address 13) will be used for RF power measurements. If the address sequence **18,13,1** is included, the LMF will use the communications system analyzer (GPIB address 18) for power measurements.
	6	Click **Apply.** The button will darken until the selection has been committed. A check mark will appear in the applicable **Manual Configuration** section check boxes for detected test equipment items.
	7	Click **Dismiss** to close the **LMF Options** window.

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Detecting Test Equipment when using Agilent E7495A

Check that no other equipment is connected to the LMF. Agilent E7495A equipment must be connected to the LAN to detect it. Then perform the procedures described in Appendix F (Specifically, see Table F-1 on page F-3, Table F-2, and Table F-3 on page F-4).

Calibrating Test Equipment

The calibrate test equipment function zeros the power measurement level of the test equipment item that is to be used for TX calibration and audit. If both a power meter and an analyzer are connected, only the power meter is zeroed.

NOTE	The Agilent E4406A transmitter tester does not support power measurement level zeroing. Refer to the Equipment Calibration section of Appendix F for E4406A calibration.

Prerequisites

- LMF computer serial port and test equipment are connected to the GPIB box.
- Test equipment to be calibrated has been connected correctly for tests that are to be run.
- Test equipment has been selected in the LMF (Table 3-25 or Table 3-26)

Calibrating test equipment

Follow the procedure in Table 3-27 to calibrate the test equipment.

Table 3-27: Test Equipment Calibration

✓	Step	Action
	1	From the **Util** menu, select **Calibrate Test Equipment** from the pull–down menu. A **Directions** window is displayed.
	2	Follow the directions provided.
	3	Click on **Continue** to close the **Directions** window and start the calibration process. A status report window is displayed.
	4	Click on **OK** to close the status report window.

Calibrating Cables Overview

The LMF Cable Calibration function is used to measure the path loss (in dB) for the TX and RX cables, adapters, directional couplers, and attenuators that make up the cable configurations used for testing. A communications system analyzer is used to measure the loss of both the TX test cable and the RX test cable configurations. LMF cable calibration consists of the following processes:

Measure the loss of a short cable

This is done to compensate for any measurement error of the communications system analyzer. The short cable, which is used only for the calibration process, is connected in series with both the TX and RX test cable configurations when they are measured.

The measured loss of the TX and RX test cable configurations minus the measured loss of the short cable equals the actual loss of the configurations. This is done so that any error in the analyzer measurement is eliminated from both the TX and RX measurements.

Measure the loss of the short cable plus the RX test cable configuration

The RX test cable configuration normally consists only of a coax cable with type–N connectors that is long enough to reach from the BTS RX connector to the test equipment.

When the BTS antenna connectors carry *duplexed TX and RX* signals, a directional coupler is required and an additional attenuator may also be required (for certain BTS types) for the RX test cable configuration. These additional items must be included in the path loss measurement.

Measure the loss of the short cable plus the TX test cable configuration

The TX test cable configuration normally consists of two coax cables with type–N connectors, a directional coupler, a termination load with sufficient rating to dissipate the BTS output power, and an additional attenuator, if required by the BTS type. The total path loss of the TX test configuration must be as required for the BTS (normally 30 or 50 dB).

The Motorola Cybertest analyzer differs from other communications system analyzers because the required attenuation/load is built into the test set. Because of this, the Cybertest TX test configuration consists only of the required length coax cable.

Calibrate Test Cabling using Communications System Analyzer

Cable Calibration is used to calibrate both TX and RX test cables. Appendix F covers the procedures for manual cable calibration.

NOTE	LMF cable calibration cannot be accomplished using an HP8921 analyzer for 1.7/1.9 GHz. A different analyzer type or the signal generator and spectrum analyzer method (Table 3-29 and Figure 3-25) must be used. Cable calibration values must be manually entered into the LMF cable loss file if the signal generator and spectrum analyzer method is used. To use the HP8921A for *manual* test cable configuration calibration for 800 MHz BTSs, refer to the Manual Cable Calibration section of Appendix F.

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Prerequisites

- Test equipment is turned on and has warmed up for at least 60 minutes. Agilent E7495A requires only 30 minute warmup.
- Test equipment has been selected in the LMF (Table 3-25 or Table 3-26).
- Test equipment has been calibrated and correctly connected for the type of test cable configuration to be calibrated.

Calibrating cables

Refer to Figure 3-12, Figure 3-13, or Figure 3-14 and follow the procedure in Table 3-28 to calibrate the test cable configurations.

Table 3-28: Test Cabling Calibration using Comm. System Analyzer

✓	Step	Action
	1	Click **Util** in the BTS menu bar, and select **Cable Calibration...** in the pull–down menu. A **Cable Calibration** window is displayed.
	2	Enter one or more channel numbers in the **Channels** box **NOTE** Multiple channels numbers must be separated with a comma, no space (i.e., 200,800). When two or more channels numbers are entered, the cables are calibrated for each channel. Interpolation is accomplished for other channels as required for TX calibration.
	3	Select **TX and RX Cable Cal**, **TX Cable Cal**, or **RX Cable Cal** in the **Cable Calibration** pick list.
	4	Click **OK**, and follow the directions displayed for each step. A status report window will be displayed with the results of the cable calibration.

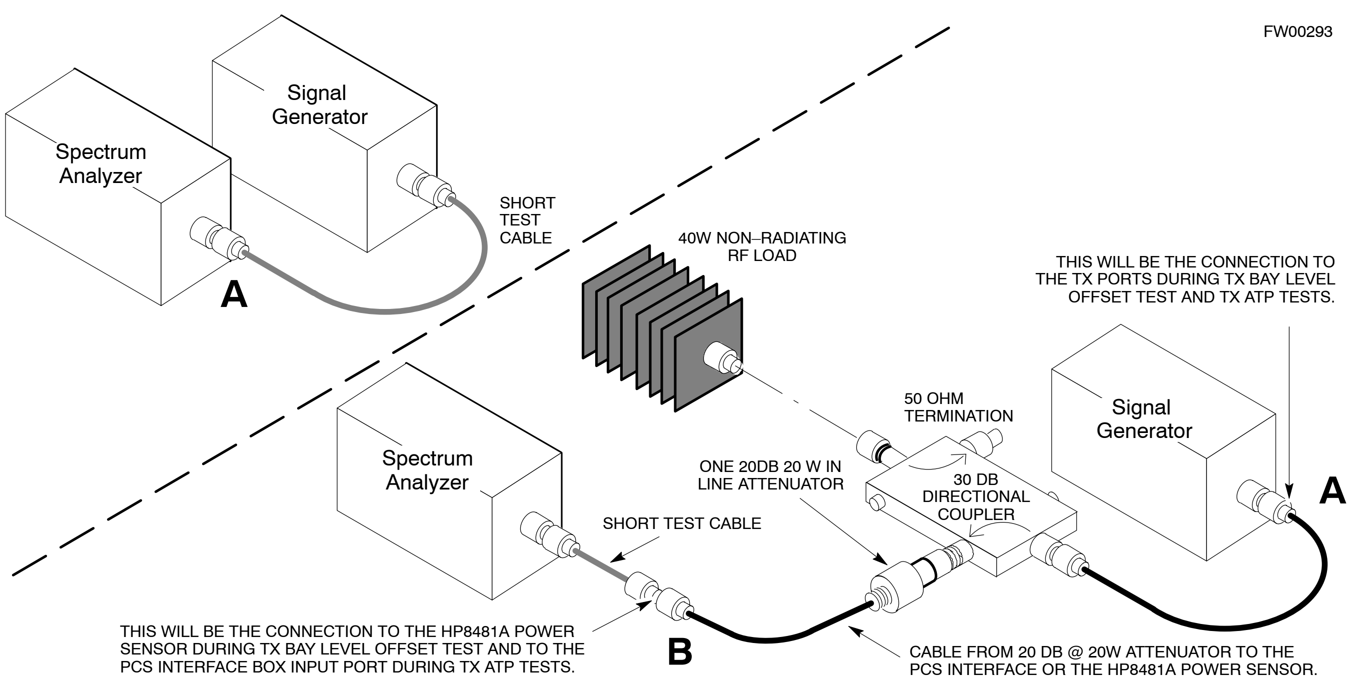
Calibrate Test Cabling Using Signal Generator & Spectrum Analyzer

Follow the procedure in Table 3-29 to calibrate the TX/Duplexed RX cables using a signal generator and spectrum analyzer. Refer to Figure 3-25, if required. Follow the procedure in Table 3-30 to calibrate the Non–Duplexed RX cables using the signal generator and spectrum analyzer. Refer to Figure 3-26, if required.

Table 3-29: Calibrating **TX/Duplexed RX** Cables Using Signal Generator & Spectrum Analyzer

Step	Action
1	Connect a short test cable between the spectrum analyzer and the signal generator as shown in Figure 3-25, detail “A” (top portion of figure).
2	Set signal generator to 0 dBm at the customer frequency of: 869–894 MHz for North American Cellular or 1930–1990 MHz for North American PCS
3	Use spectrum analyzer to measure signal generator output (see Figure 3-25, **A**) & record the value.
4	Connect the spectrum analyzer’s short cable to point **B**, (as shown in the lower right portion of the diagram) to measure cable output at customer frequency of: 869–894 MHz for North American Cellular or 1930–1990 MHz for North American PCS Record the value at point **B**.
5	Calibration factor = (value measured with detail “A” setup) – (value measured with detail “B” setup) Example: Cal factor = –1 dBm – (–53.5 dBm) = 52.5 dB **NOTE** The short cable is used for *calibration only*. It is *not* part of the final test setup. After calibration is completed, *do not* re-arrange any cables. Use the test cable configuration as is to ensure test procedures use the correct calibration factor.

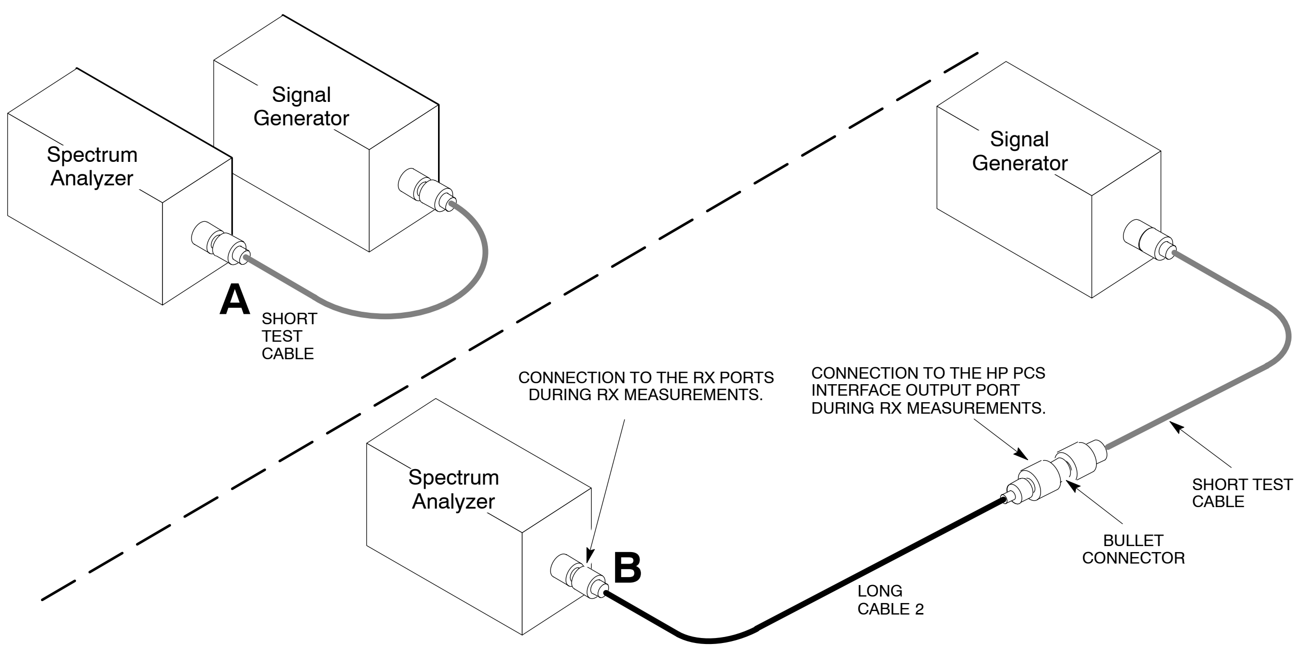
Figure 3-25: Cal Setup for TX/Duplexed RX Test Cabling Using Signal Generator & Spectrum Analyzer



3

Table 3-30: Calibrating Non–Duplexed RX Cables Using a Signal Generator &Spectrum Analyzer	
Step	**Action**
1	**NOTE** When preparing to calibrate a BTS with **Duplexed TX and RX** the RX cable calibration must be done using calibration setup in Figure 3-25 and the procedure in Table 3-29. Connect a short test cable between the spectrum analyzer and the signal generator as shown in Figure 3-26, detail "A" (top portion of figure).
2	Set signal generator to –10 dBm at the customer's RX frequency of: 824–849 for North American Cellular or 1850–1910 MHz band for North American PCS
3	Use spectrum analyzer to measure signal generator output (see Figure 3-26, **A**) and record the value.
4	Connect the test setup, as shown in the lower portion of the diagram (see Figure 3-26, **B**) to measure the output at the customer's RX frequency of: 824–849 for North American Cellular or 1850–1910 MHz band for North American PCS Record the value at point **B**.
5	Calibration factor = (value measured with detail "A" setup) – (value measured with detail "B" setup) Example: Cal factor = –1 dBm – (–53.5 dBm) = 52.5 dB **NOTE** The short cable is used for *calibration only*. It is *not* part of the final test setup. After calibration is completed, *do not* re-arrange any cables. Use the test cable configuration as is to ensure test procedures use the correct calibration factor.

Figure 3-26: Cal Setup for Non–Duplexed RX Test Cabling
Using Signal Generator & Spectrum Analyzer



Setting Cable Loss Values

Cable loss values for TX and RX test cable configurations are normally set by accomplishing automatic cable calibration using the LMF and the applicable test equipment. The LMF stores the measured loss values in the cable loss files. The cable loss values can also be set or changed manually. Follow the procedure in Table 3-31 to set cable loss values.

CAUTION	If cable calibration was performed without using the LMF, cable loss values *must* be manually entered in the LMF database. Failure to do this will result in inaccurate BTS calibration and reduced site performance.

Prerequisites

- LMF is logged into the BTS

Table 3-31: Setting Cable Loss Values

Step	Action
1	Click **Util** in the BTS menu bar, and select **Edit > Cable Loss** in the pull–down menus. – A *tabbed* data entry pop–up window will appear.
2	Click on the **TX Cable Loss** tab or the **RX Cable Loss** tab, as required.
3	To add a new channel number, perform the following:
3a	– Click on the **Add Row** button.
3b	– Click in the **Channel #** or **Loss (dBm)** column, as required.
3c	– Enter the desired value.
4	To edit existing values, click in the data box to be changed and change the value.
5	To delete a row, click on the row and then click on the **Delete Row** button.
6	*For each tab with changes*, click on the **Save** button to save displayed values.
7	Click on the **Dismiss** button to close the window. **NOTE** • Values entered or changed after the **Save** button was used will be lost when the window is dismissed. • If cable loss values exist for two different channels the LMF will interpolate for all other channels. • Entered values will be used by the LMF as soon as they are saved. It is not necessary to log out and log back into the LMF for changes to take effect.

Setting TX Coupler Loss Values

If an in–service TX coupler is installed, the coupler loss (e.g., 30 dB) must be manually entered so it will be included in the LMF TX calibration and audit calculations and RX FER Test. Follow the procedure in Table 3-32 to set coupler loss values.

Prerequisites

- LMF is logged into the BTS
- Path loss, in dB, of the TX coupler must be known

Setting loss values

Table 3-32: Setting TX Coupler Loss Value

Step	Action
1	Click **Util** in the BTS menu bar, and select **Edit > Coupler Loss...** in the pull–down menus. – A *tabbed* data entry pop–up window will appear.
2	Click on the **TX Coupler Loss** tab or the **RX Coupler Loss** tab, as required
3	Click in the **Loss (dBm)** column for each carrier that has a coupler and enter the appropriate value.
4	To edit existing values, click in the data box to be changed and change the value.
5	*For each tab with changes*, click on the **Save** button to save displayed values.
6	Click on the **Dismiss** button to close the window. **NOTE** • Values entered or changed after the **Save** button is used will be lost when the window is dismissed. • The **In–Service Calibration** check box in the **Tools > Options > BTS Options** tab must be checked before entered TX coupler loss values will be used by the TX calibration and audit functions. • New or changed values will be used by the LMF as soon as they are saved. Logging out and logging in again *are not required* to cause saved changes to take effect.

Bay Level Offset Calibration

Introduction

Bay Level Offset (BLO) calibration is the central activity of the optimization process. BLO calibration compensates for normal equipment variations within the BTS RF paths and assures the correct transmit power is available at the BTS antenna connectors to meet site performance requirements.

RF Path Bay Level Offset Calibration

Calibration identifies the accumulated gain in every transmit path (BBX slot) at the BTS site and stores that value in a BLO database calibration table in the LMF. The BLOs are subsequently downloaded to each BBX.

For starter frames, each receive path starts at a BTS RX antenna port and terminates at a backplane BBX slot. Each transmit path starts at a BBX backplane slot, travels through the Power Amplifier (PA) and terminates at a BTS TX antenna port.

For expansion frames each receive path starts at the BTS RX port of the cell site starter frame, travels through the frame-to-frame expansion cable, and terminates at a backplane BBX slot of the expansion frame. The transmit path starts at a BBX backplane slot of the expansion frame, travels though the PA and terminates at a BTS TX antenna port of the same expansion frame.

Calibration identifies the accumulated gain in every transmit path (BBX slot) at the BTS site and stores that value in a BLO database. Each transmit path starts at a C–CCP shelf backplane BBX slot, travels through the PA, and ends at a BTS TX antenna port. When the TX path calibration is performed, the RX path BLO is automatically set to the default value.

At omni sites, BBX slots 1 and 13 (redundant) are tested. At sector sites, BBX slots 1 through 12, and 13 (redundant) are tested. Only those slots (sectors) *actually equipped* in the current CDF are tested, regardless of physical BBX board installation in the slot.

When to Calibrate BLOs

Calibration of BLOs is required:

- After initial BTS installation
- Once each year
- After replacing any of the following components or associated interconnecting RF cabling:
  - BBX board
  - C–CCP shelf
  - CIO card
  - CIO to Power Amplifier backplane RF cable
  - PA backplane
  - PA
  - TX filter / TX filter combiner
  - TX thru-port cable to the top of frame

TX Path Calibration

The TX Path Calibration assures correct site installation, cabling, and the first order functionality of all installed equipment. The proper function of each RF path is verified during calibration. The external test equipment is used to validate/calibrate the TX paths of the BTS.

WARNING	***Before*** installing any test equipment directly to any **TX OUT** connector you must ***first verify that there are no CDMA channels keyed***. Have the OMC–R place the sector assigned to the LPA under test OOS. Failure to do so can result in serious personal injury and/or equipment damage.

CAUTION	Always wear a conductive, high impedance wrist strap while handling any circuit card/module. If this is not done, there is a high probability that the card/module could be damaged by ESD.

NOTE

At new site installations, to facilitate the complete test of each CCP shelf (if the shelf is not already fully populated with BBX boards), move BBX boards from shelves currently not under test and install them into the empty BBX slots of the shelf currently being tested to insure that all BBX TX paths are tested.

– This procedure can be bypassed on operational sites that are due for periodic optimization.

– Prior to testing, view the CDF file to verify the correct BBX slots are equipped. Edit the file as required to include BBX slots not currently equipped (per Systems Engineering documentation).

BLO Calibration Data File

During the calibration process, the LMF creates a **bts–n.cal** calibration (BLO) offset data file in the **bts–n** folder. After calibration has been completed, this offset data must be downloaded to the BBXs using the Download BLO function. An explanation of the file is shown below.

NOTE	Due to the size of the file, Motorola recommends that you print out a hard copy of a bts.cal file and refer to it for the following descriptions.

The CAL file is subdivided into sections organized on a per slot basis (a slot Block).

Slot 1 contains the calibration data for the 12 BBX slots. Slot 20 contains the calibration data for the redundant BBX. Each BBX slot header block contains:

- A creation Date and Time – broken down into separate parameters of createMonth, createDay, createYear, createHour, and createMin.
- The number of calibration entries – fixed at 720 entries corresponding to 360 calibration points of the CAL file including the slot header and actual calibration data.

- The calibration data for a BBX is organized as a large flat array. The array is organized by branch, sector, and calibration point.
  – The first breakdown of the array indicates which branch the contained calibration points are for. The array covers transmit, main receive and diversity receive offsets as follows:

Table 3-33: BLO BTS.cal File Array Assignments

Range	Assignment
C[1]–C[240]	Transmit
C[241]–C[480]	Main Receive
C[481]–C[720]	Diversity Receive

NOTE Slot 385 is the BLO for the RFDS.

– The second breakdown of the array is per sector. Configurations supported are Omni, 3–sector or 6–sector.

Table 3-34: BTS.cal File Array (Per Sector)

BBX	Sectorization		TX	RX	RX Diversity
Slot[1] (Primary BBXs 1 through 12)					
1 (Omni)	6 Sector, 1st Carrier	3–Sector, 1st Carrier	C[1]–C[20]	C[241]–C[260]	C[481]–C[500]
2			C[21]–C[40]	C[261]–C[280]	C[501]–C[520]
3			C[41]–C[60]	C[281]–C[300]	C[521]–C[540]
4		3–Sector, 3rd Carrier	C[61]–C[80]	C[301]–C[320]	C[541]–C[560]
5			C[81]–C[100]	C[321]–C[340]	C[561]–C[580]
6			C[101]–C[120]	C[341]–C[360]	C[581]–C[600]
7	6 Sector, 2nd Carrier	3–Sector, 2nd Carrier	C[121]–C[140]	C[361]–C[380]	C[601]–C[620]
8			C[141]–C[160]	C[381]–C[400]	C[621]–C[640]
9			C[161]–C[180]	C[401]–C[420]	C[641]–C[660]
10		3–Sector, 4th Carrier	C[181]–C[200]	C[421]–C[440]	C[661]–C[680]
11			C[201]–C[220]	C[441]–C[460]	C[681]–C[700]
12			C[221]–C[240]	C[461]–C[480]	C[701]–C[720]

. . . continued on next page

Table 3-34: BTS.cal File Array (Per Sector)					
BBX	**Sectorization**		**TX**	**RX**	**RX Diversity**
Slot[20] (Redundant BBX–13)					
1 (Omni)	6 Sector, 1st Carrier	3–Sector, 1st Carrier	C[1]–C[20]	C[241]–C[260]	C[481]–C[500]
2			C[21]–C[40]	C[261]–C[280]	C[501]–C[520]
3			C[41]–C[60]	C[281]–C[300]	C[521]–C[540]
4		3–Sector, 3rd Carrier	C[61]–C[80]	C[301]–C[320]	C[541]–C[560]
5			C[81]–C[100]	C[321]–C[340]	C[561]–C[580]
6			C[101]–C[120]	C[341]–C[360]	C[581]–C[600]
. . . continued on next page					
7	6 Sector, 2nd Carrier	3–Sector, 2nd Carrier	C[121]–C[140]	C[361]–C[380]	C[601]–C[620]
8			C[141]–C[160]	C[381]–C[400]	C[621]–C[640]
9			C[161]–C[180]	C[401]–C[420]	C[641]–C[660]
10		3–Sector, 4th Carrier	C[181]–C[200]	C[421]–C[440]	C[661]–C[680]
11			C[201]–C[220]	C[441]–C[460]	C[681]–C[700]
12			C[221]–C[240]	C[461]–C[480]	C[701]–C[720]

- Ten calibration points per sector are supported for each branch. Two entries are required for each calibration point.
- The first value (all odd entries) refer to the CDMA channel (frequency) where the BLO is measured. The second value (all even entries) is the power set level. The valid range for PwrLvlAdj is from 2500 to 27500 (2500 corresponds to –125 dBm and 27500 corresponds to +125 dBm).
- The 20 calibration entries for each sector/branch combination must be stored in order of increasing frequency. If less than 10 points (frequencies) are calibrated, the largest frequency that is calibrated is repeated to fill out the 10 points.

  Example:
  C[1]=384, *odd cal entry*
  = *1 "calibration point"*
  C[2]=19102, *even cal entry*
  C[3]=777,
  C[4]=19086,
  .
  .
  C[19]=777,
  C[20]=19086, (since only two cal points were calibrated this would be repeated for the next 8 points)

- When the BBX is loaded with image = data, the cal file data for the BBX is downloaded to the device in the order it is stored in the cal file. TxCal data is sent first, C[1] – C[240]. Sector 1's ten calibration points are sent (C[1] – C[20]) followed by sector 2's ten calibration points (C[21] – C[40]), etc. The RxCal data is sent next (C[241] – C[480]), followed by the RxDCal data (C[481] – C[720]).
- Temperature compensation data is also stored in the cal file for each set.